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THE INDUCTION GENERATOR.

That the alternating-current induction machine with a short-circuited or squirrel-cage rotor winding will generate current from mechanical power is well known, but the advantages and disadvantages of its use in this manner are not generally appreciated, such machines having never been run commercially as generators.

To run such a machine as a generator some means of excitation must, of course, be provided, and the simplest and most obvious method of exciting the machine is the use of condensers connected straight across the mains. This method is perfectly practicable, the main objection to it being due to the fact that the machine acts as does a self-exciting shunt-wound direct-current generator, the voltage being very unstable, until the excitation is carried above the bend of the magnetization curve, since below this point any slight change of speed or load changes the voltage, which in turn reacts upon the excitation, further changing the voltage, the condition being a very unstable one, as the voltage is dependent on the excitation and the excitation is dependent on the voltage. Above the bend of the magnetization curve the magnetization is not proportional to the voltage and the excitation becomes more stable. This is a serious barrier to the use of such excitation with alternating-current induction generators, since the running of the iron above saturation at commercial frequencies involves a serious hysteresial loss. This objection, of course, does not apply to direct-current self-exciting shunt-wound machines. Another objection to this means of excitation is the fact that any change of the power factor of the load interferes seriously with the excitation. The addition of a lagging current equal in magnitude to the leading current taken by the condensers for field excitation purposes would immediately kill the excitation completely. There is, moreover, no apparent means of compounding an induction generator with such excitation.

Another and more promising means of exciting induction generators is the running upon the same circuits of synchronous excited field machines which, under such conditions, automatically adjust their phase relations with that of the generator so as to give the latter an exciting current, this action continuing with any variation of the magnitude or power factor of the external load within limits, the synchronous machine taking up, so to speak, all leading or lagging currents in itself, with the exception solely of that necessary to excite the induction generator to a voltage approximately equal to that determined by the speed, field excitation and armature reaction of the synchronous machine. A system consisting of an induction generator running a synchronous motor acts very much as does that consisting of a synchronous or ordinary generator running an induction motor, with one notable exception, which is to the great advantage of the induction generator for power transmission purposes. With the generator of the induction type and the motor of the synchronous type the wattless currents on the line are leading, while with the reversed combination (that common in contemporaneous practice) the wattless currents are lagging. With long lines, step-up and step-down transformers these lagging currents increase materially the ohmic drop of the system, while on the other hand, the leading currents would not only not increase the ohmic drop, but reacting upon the self-induction of the line would

compensate for it and with proper conditions compound the voltage to a constant value independent of the load at the point of consumption, or even over-compound it, if desired. Furthermore, the regulation of the voltage would be entirely at the motor end of the system, the point where it is definitely known what voltage is desired.

It is certainly unnecessary in well-designed installations to have the system excited at both ends, and the advantages of placing the excitation at the motor end certainly indicate that present practice is in the wrong direction. Where rotary converters are used and some of the excitation must on their account necessarily be at the receiving end of the alternating system, and where, further, the direct-current voltage is intimately dependent upon the excitation of the alternating-current system, it would certainly be advisable to use induction generators whereby the determination of the voltage would be taken absolutely out of the hands of the attendant at the generating station and put into the hands of the attendant at the rotary, who, by adjusting his field rheostats for the proper direct-current voltage, would thereby fix the alternating-current voltage to suit. A still further advantage of this system is the ease with which such generators can be handled, there being no necessity of synchronizing apparatus, the machines adjusting their own phase relations on being switched together and there being further no real necessity of their running in exact synchronism, thereby eliminating the difficulties now obtained with isochronous or practically isochronous governors on synchronous generators run in multiple. With induction machines there would also be no trouble with the beating or oscillating of the rotating parts of the generators.

THE TROLLEY SWITCH CASE.

The United States Circuit Court of Appeals has rendered a decision in the case of the Thomson-Houston Electric Company vs. the Elmira & Horseheads Railroad Company, which, as is well known, is the case of the General Electric Company against the Walker Company, claiming an infringement of the Van Depoele patent No. 424,694 on overhead trolley switches. This decision, although it decrees some of the claims as void and others as not infringed, upholds in general the opinion of the lower court and considers a large number of claims valid and infringed. These claims cover the device universally used to switch overhead trolley wheels, consisting of a Y-shaped plate with depending flanges forming a shallow open bottom box into which the trolley wheel may run with its flanges bearing against the plate and in which it may be deflected to one side or the other by the lateral movement of the car on the track switch below.

The argument advanced by the defendant was that the claims were void for want of patentable novelty and that the invention had been previously patented by the same inventor. With regard to the first point it was argued that the switch was simply a track frog inverted, modified in detail and hung from the trolley wire supports. The decision states that "the ordinary track frog as a constructural device has only a remote resemblance to it. The suggestion that it could be utilized in the overhead line wire junction would seem ridiculous, and it could only be done by denuding it of its most conspicuous characteristic. * * * It was not a great invention, but that it was an invention requiring a degree of ingenuity somewhat beyond the ordinary skill of the calling we are unable to doubt." The question of previous patenting by the same inventor hinges upon certain fine points of patent law, the previous patents all having been applied for when the application for the patent in suit was pending in the Patent Office. The decision holds that the previous patents were not for the same invention, but for structural improvements in the same, and that, therefore, the broader claims in the patent in suit are valid.

The decision is a most important one, as trolley switches are vitally necessary in the operation of overhead trolley systems. An injunction obtained under this decision may be noted in another column in this issue.

UNDERGROUND INSULATION.

Since the number of wires in large cities has become absolutely too great for overhead accommodation, thereby necessitating the placing of the wires under ground, many solutions of the apparently overwhelming difficulties of this problem have been found. The highest achievement of good engineering, however, is the successful accomplishment of a purpose at a low cost, and in this respect the insulation of underground wiring has been a notable failure. Every successful system so far introduced has been expensive, and those most successful are ruinously so for anything but use in districts of highly concentrated population where correspondingly large returns from the service which the wires perform can be obtained. The whole problem is the covering of the copper conductor with an insulating material which in turn must be protected from moisture and mechanical disturbances. This is usually accomplished by a covering of india rubber or some equivalent insulation surrounded in turn by a shell of lead which in turn may be surrounded by an iron pipe and this again by concrete. The reasons for the need of this number of protections are obvious on a little thought. The rubber is, of course, the insulating medium; the lead is essential to protect the rubber from moisture, the iron in turn is needed to protect the lead mechanically, and the external concrete or cement to protect the iron from corrosion.

The production of an insulating duct has never been successfully accomplished, the difficulty apparently being that the duct, if vitreous, is brittle and easily broken, and if not vitreous is not moisture-proof. The use of conductors made up in short lengths in metallic pipes and joined together by junction boxes is going out of favor wherever drawn-in systems can be substituted, the troubles and difficulties encountered with the many junction boxes being the chief cause of this disfavor. The troublesome junction boxes are, however, of value where branches are frequent, so that in low tension lighting service, it has become now quite customary to use drawn-in conductors for the feeders and sectional conductors for the mains, from which the services are tapped off.

In Europe the concentric cable is in favor where two or three polarities run together, while in this country it is more customary to lap up three-round conductors in one cable. The concentric arrangement undoubtedly economizes both space and insulation for a given minimum distance between conductors, but involves considerable difficulties in joints and taps. European manufacturers have also adopted quite generally the use of a cable made up of close-fitting strands with segmental instead of circular cross section, whereby the diameter of the conductor for a given number of circular mils and the quantity of insulation required to surround it are considerably reduced. Concentric cables with the outer annular conductors made up in this way, the segments becoming copper tape, make a very compact and flexible arrangement.

A New Cable Steamer.

A four-masted twin-screw steamship, said to be the largest cable steamer afloat, has been launched for the Telegraph Construction & Maintenance Company. The craft is 440 feet long between perpendiculars, fitted with vertical cable drums, and in four of the holds are circular cable tanks about 45 feet in diameter and from 17 to 32 feet in depth.

The Construction of a 150,000 Volt Transformer.*

BY ELLERY B. PAINE AND HARRY E. GOUGH.

As a subject for post-graduate thesis work at the Worcester Polytechnic Institute during the past year the writers have designed and constructed a 150,000-volt transformer, and as some radical changes from the usual method of transformer construction are necessary when dealing with such high potentials a short description of this piece of apparatus may be of interest.

The source of supply of current for the transformer is the 30-kw Westinghouse smooth-core alternator situated in the power laboratory. This machine has a frequency of 133 cycles and its virtual voltage is 1000. Since it would not be convenient to arrange the necessary switches and circuit breakers in a 1000-volt circuit, it was decided to reduce the pressure by means of small transformers, and in this way the supply for the high-potential transformer could be either 50 volts or 100 volts as desired, with the alternator excited so as to give 1000 volts on the line.

As there were ten transformers available for this purpose, and the capacity of each was 2 kilowatts, the output of the high-potential transformer was limited to 20 kilowatts. From this it is seen that the problem was to design a 20-kw transformer for a frequency of 133 p. p. s. to give 150,000 volts at the terminals of the secondary with 100 volts supplied to the primary. In working out the design the end kept in view was to produce a transformer which would give the highest insulation for the lowest first cost of materials, and an efficiency sufficiently high to maintain good regulating qualities.

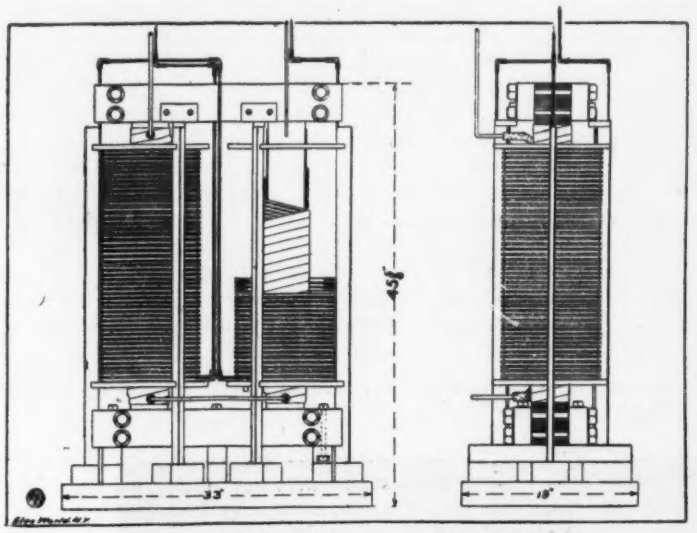


FIG. 1.—DETAIL ELEVATIONS OF TRANSFORMER.

The core type of transformer was selected for this case because that form seemed to offer better means for insulation than did the shell type, and would at the same time be easier to build. With a virtual voltage of 150,000 at the terminals of the secondary the maximum voltage to which the insulation will be subjected is 150,000 x 1.4, or over 200,000 volts, since the E. M. F. wave of the alternator is very nearly sinusoidal. With this voltage a spark will jump across an air space of about 15 inches, whence it is evident that the transformer must be surrounded by some better insulating dielectric than air. To determine what was the best oil to use for this transformer a series of comparative tests was made with different commercial oils. In making these tests an induction coil giving an E. M. F. of approximately 15,000 volts was used. From the results obtained in this way, together with the results obtained by other experimenters, it was decided that kerosene oil would be used, and it was estimated that 3" of this oil would withstand a potential of 200,000 virtual volts. To find out if the oil would be apt to take fire if it were used and sparks should pass through it heavy arcs were formed in a sample of kerosene; and in no case was the oil observed to take fire.

From preliminary calculations carried through with different values of magnetic density in the core and different core areas, it was decided that a maximum core density of 8128 gausses per square centimeter should be used. The core is rectangular in form and the windings surround the two vertical legs. It is built up of soft iron strips 0.025 inches thick, and the over-all dimensions are 18½" by 39". The two upright parts are composed of strips of different widths, so that the form of cross section is approximately a circle a little over 4 inches in diameter. The actual area of cross section of iron in the core limbs is 78.7 square centimeters, so that the total flux passing through the windings is 640,000 webers. The yoke pieces are built up of strips 4 inches wide, and the area of cross sections at this point is 92.9 sq. cen. At the joints some of the laminations overlap, and the remainder are butted together. The laminations are held in place by means of two pairs of wooden pieces placed on either side of the yokes and drawn up by bolts.

This construction is shown in the accompanying drawing, Fig. 1, and also in the reproduction of a photograph, Fig. 2. The limbs of the core are covered with four thicknesses of heavy duck, and over this is wound one even layer of braided cotton rope about three-sixteenth inch in diameter. This is covered with two more thicknesses of duck, and over this is wound the primary conductor. This winding consists of six No. 4 B. & S. double cotton-covered wires connected in parallel. There are thirteen turns around each limb, making twenty-six turns in the primary coil. The primary wire is covered with two thicknesses of duck.

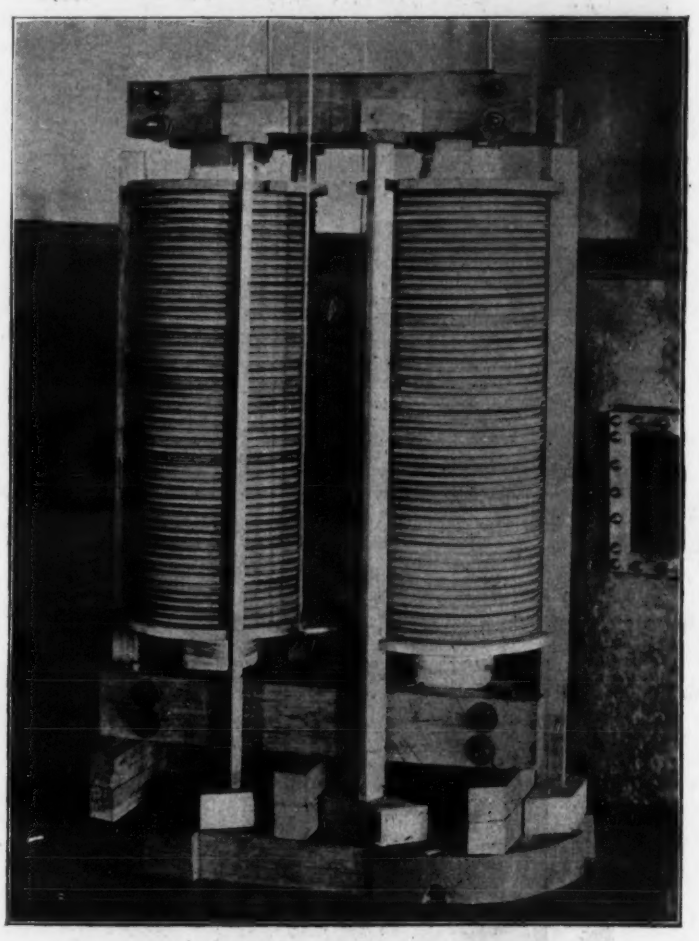


FIG. 2.—VIEW OF TRANSFORMER.

The secondary coil consists of 39,200 turns of No. 30 B. & S. double cotton-covered wire. In order to increase the insulation of the coil it is divided into a hundred sections, fifty of which are placed on each limb. Thus the number of turns in each section is 392, and the potential between any two consecutive sections is 1500 volts. These sections are wound upon wooden rings, as shown in the cut. These rings are turned from well-seasoned soft pine and are 10¾ inches in outside diameter. The wire is placed in a groove ¼" wide and 1" deep. The inside diameter is 8¼", which allows 1½" of clear oil space between the ring and the primary wire. This forces the spark to traverse 3" of oil should it break down through the primary winding or the core. The wooden rings are supported by wooden frames, as may be seen in the cuts. Both these frames and the core are fastened firmly to a plank 2⅝" thick, which serves as a base, and the whole is placed in a galvanized iron tank filled with oil. In two opposite sides of this tank are placed two glass windows, and through these one is able to observe the condition of things within the tank.

*Written for the "Journal of the Worcester Polytechnic Institute."

Fig. 3.

The tank contains 110 gallons of kerosene oil, and the top is covered by plates of glass. All connections to the two windings are made through the top of the tank. The primary wires are not insulated, but the secondary terminals are inclosed in glass tubes with glass elbows at the bends. After the terminals of the secondary leave the oil they are kept at least 14" apart, besides being inclosed in glass tubes.

Before the secondary coils were connected permanently in series experiments were made with the sections joined in parallel to determine:—

The no-load current.	The efficiency.
The core loss at various voltages.	The resistances.
The ratio of transformation.	The regulation curve.

The following table shows a comparison of the calculated and observed values:

	Calculated.	Observed.
NO-LOAD CURRENT.		
Pri. voltage, 50,	19.2 Amp.	18.8 Amp.
" " 100,	33.2 "	34.3 "
CORE LOSS.		
Pri. voltage, 50,	815. Watts.	875. Watts.
" " 100,	2,821. "	——— "
Ratio of transformation,	1,508.	1,504.
Drop at full load,	2.1	2.2%
Pri. resistance, 18° C.,	0.0023*	0.003 ohms.
Sec. " 18° C.,	10,029.	9,860 "
EFFICIENCY.		
10 K. W. 75,000 volts,	89.7%	89.3%

The fields of work in which a transformer of this character may be used are many. One of the most important and practical of these is the study of insulating materials with regard to their properties for preventing disruptive discharges. Another subject which has, as yet, received comparatively little attention is the production of ozone. Perhaps the most interesting experiments are those showing various sorts of discharges in air. What is known as a brush discharge may be produced by connecting the secondary terminals to wires inclosed in glass tubes, placed parallel to each other 8 or 10 inches apart. When the voltage is raised to about 80,000 volts, the space between the tubes will be filled with a violet colored flame, and at the same time brilliant sparks will be seen darting in crooked paths between the tubes. Another interesting display may be obtained by placing the two terminals on opposite sides of a glass plate, when, if the distance is not too great, the

*No allowance was made in the calculations for the resistance of six soldered joints in the primary winding.

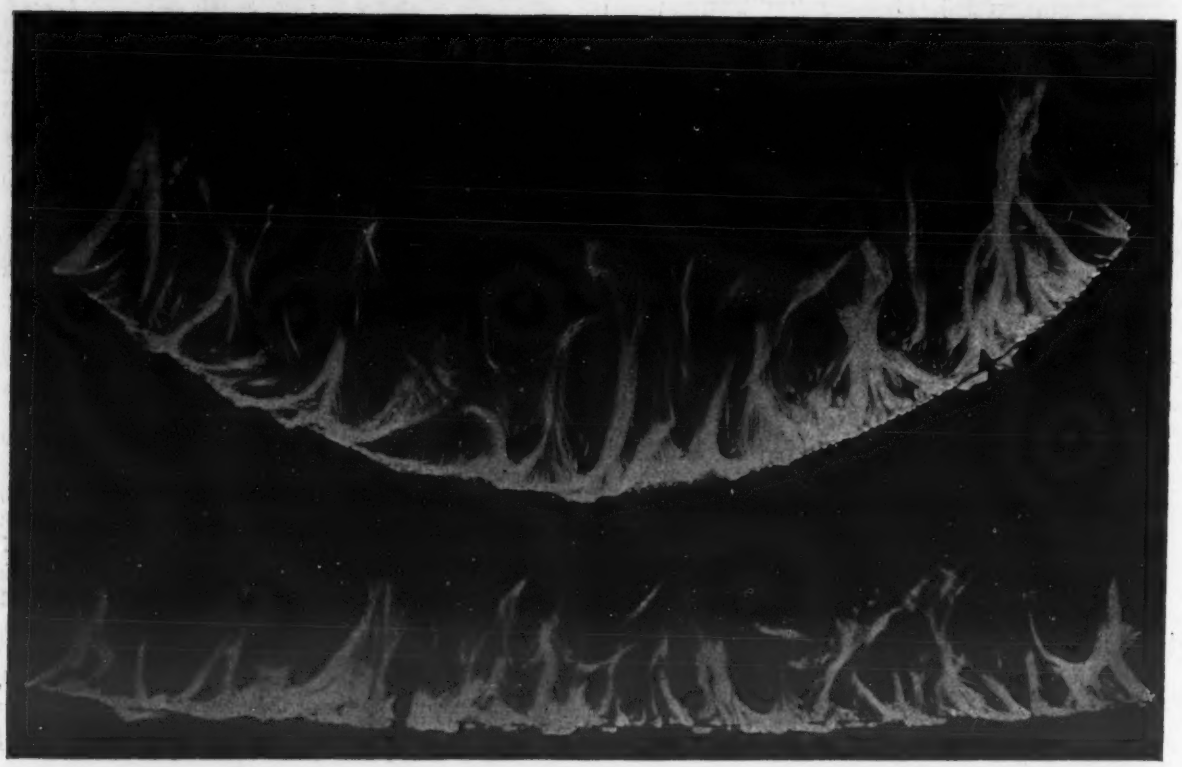


Fig. 4.

sparks will pass around the edge of the plate causing brilliant flashes and a peculiar crackling sound. In both of these discharges a large quantity of ozonized air is produced, and the glass soon becomes very warm.

The most interesting form of discharge is produced by forcing the current to jump from one terminal to the other through a clear air space, thus establishing an arc. These discharges are studied best by the aid of a camera, since it can record many of the effects produced which are of such short duration as to be scarcely noticed by observing the discharge with the eye.* The plates show reproductions of a few photographs of this variety of discharge. The group of Fig. 3 shows a series of disruptive discharges between rounded terminals separated various distances. All of these arcs were of very short duration, since as soon as the arc was once formed the current taken by the transformer was so great that the circuit-breaker in the primary circuit was thrown out. The longest of these arcs was 14 inches and the voltage for this discharge was about 190,000 volts maximum. The two reproductions in Fig. 4 show the discharge that takes place when a string slightly moistened with salt water is stretched between the terminals. The first of these discharges was 23 inches long, and the second was 31 inches.

The lower reproduction in Fig. 5 shows a disruptive discharge through air 18 inches long. The potential required to start this arc was about 231,000 volts maximum, and from the readings of the instruments in the power-house it was estimated that the energy absorbed in this discharge was over 50 horse-power. The second reproduction on this plate shows an arc being maintained between two electrodes placed on the same level and over 20 inches apart. This arc was started with a short gap and low potential, and then the arc was drawn out and the voltage at the same time was raised. This illustrates the arched form always taken by the arc under these conditions on account of the ascending currents of heated air.

In Fig. 6 is seen a large triple petticoat potential insulator as it is breaking down under a maximum potential of about 130,000 volts. In this test one wire was connected to the wooden insulator pin, which was moistened, and the other to the top of the insulator. The oother reproduction shows a 13-inch discharge.

*See article by Steinmetz in THE ELECTRICAL WORLD. Vol. XXXI, page 294.

FIG. 6.

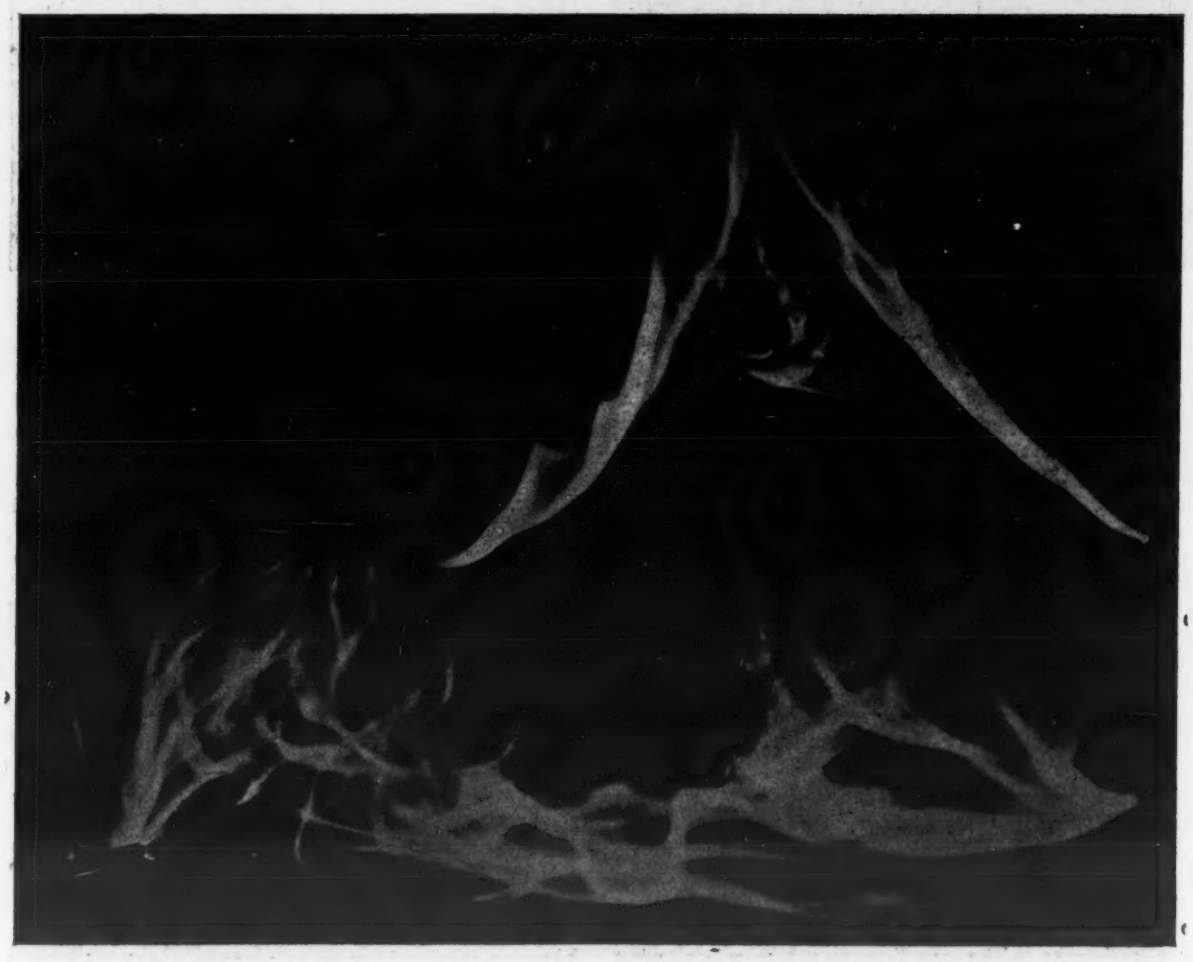


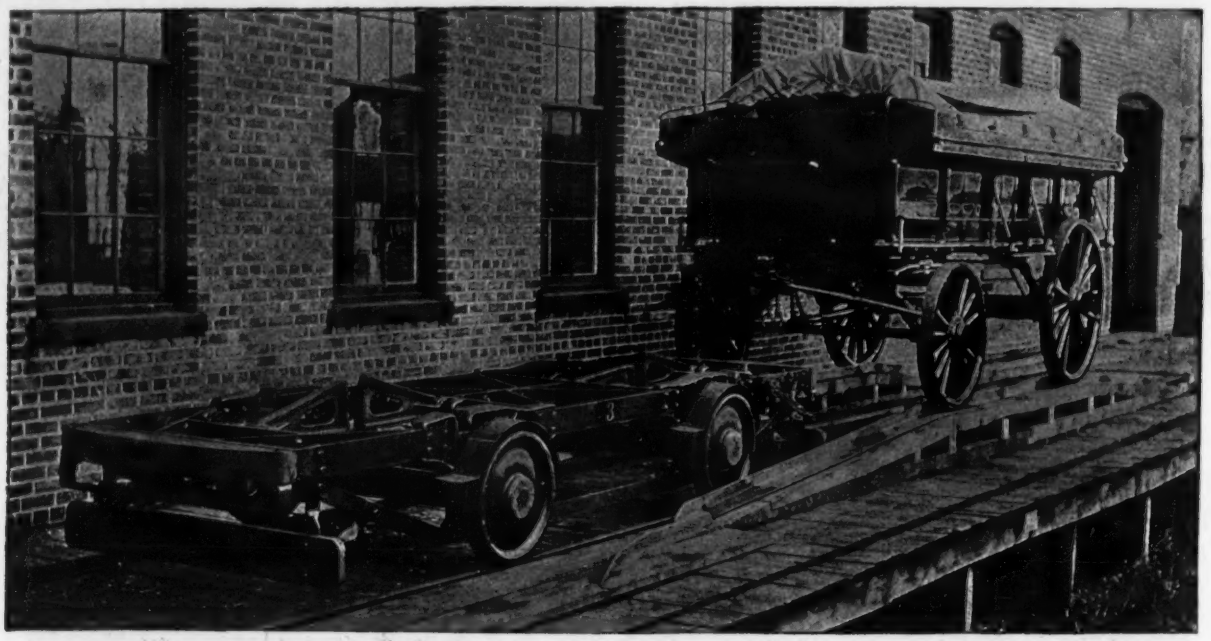
FIG. 5.

Freight Traffic on Electric Railways.

In a paper read before the convention of the Canadian Electrical Association, entitled "The Unconscious Ownership of an Important Key," Mr. W. T. Bonner described a novel method of handling farm produce and other highway freight by suburban and interurban electric roads. It was pointed out that the cost on ordinary highways is enormous compared with that on railways, so that a large amount of land quite near the large centres of population is handicapped in reaching the market in comparison with land situated perhaps thousands of miles away, but requiring a shorter wagon haul. On the other hand, the extensive terminal facilities required with standard railroad system run up the cost of short-haul business on railroads to a high figure per mile compared with the long-haul traffic.

A method of providing freight haulage to districts near the large centres of population at a low cost has been worked out by the Bonner Rail Wagon Company by means of trailer trucks fitted for the ready reception of ordinary wagons. By this means milk, market produce, express, baggage, and, in fact, any traffic that is now hauled at great expense from centres of population to the outlying districts by horses, or, in case this becomes too expensive, is sent by rail, freight or express with the attendant trans-shipment and terminal charges at both ends, may be carried in wagons directly from the place of shipment to destination without trans-shipment and without long and expensive animal haulage. The wagon is not materially different from those of standard construction, but is simply fitted with devices for its ready attachment to the truck over which it rides in loading. The truck is also practically the same as that in general use upon electric railways. The actual time required for shipping or unshipping the wagon from the truck is said to be not more than that required for coupling cars.

It is obvious that this same principle can be made use of without any special devices other than flat cars and platforms by which ordinary wagons may be run on to the cars, to which they can be blocked and chained. The additional freight traffic secured in this way would in many cases increase materially the income of suburban roads with light service, with a comparatively small increase in the total expenses.



Truck and Wagon for Freight Carriage on Electric Railways.

A Conductor Having No Resistance.

It appears that in Professor Dewar's recent experiments with the liquefaction of hydrogen the platinum resistance thermometer which he used was cooled to within 6 "platinum" degrees of its zero point, and that if it had been cooled these few degrees more, which it is claimed could have been done by boiling the hydrogen under reduced pressure, the platinum would have become a conductor of zero resistance. The question naturally arises, what would be its resistance if the temperature is lowered still more?

The Visit of the "Yankee" to New York.

The United States auxiliary cruiser "Yankee," on which there are quite a number of men formerly connected with the electrical industries, arrived in New York on Wednesday morning, July 6, nominally on a trip for stores, provisions, ammunition, coal, etc. Mr. S. Dana Greene, of the General Electric Company, is the most prominent of those on board engaged in electrical engineering pursuits in times of peace, among whom are several of the officers and technical employees of the New York Edison Illuminating Company and others engaged in engineering work in New York City, all of whom joined the Naval Reserves and were called out on the "Yankee" when this ship, formerly the "El Nord" of the Morgan line, was converted into a cruiser. The electric light plant of the cruiser should certainly be well managed, as it has been placed in the hands of Mr. H. K. Coolidge, formerly of the New York Edison Company, who is assisted in handling the engine and dynamo by Mr. Thomas B. Cummings, formerly with Henry R. Worthington; Mr. John Gray, formerly consulting engineer of the Tidewater Oil Company, and Mr. John Gilmour, formerly with the Hall Signal Company. Among the others on board are Messrs. Kellogg, Stebbins and De Kay, of the New York Edison Company, who are now gunners' mates, besides many other gentlemanly fellows who are serving in similar capacities or as seamen, performing rather menial duties for men of their calibre, but taking pleasure in them for love of their country. The "Yankee" is fitted with ten 5-inch rapid-fire, ten six-pounders and two Colt automatic guns. She has not been backward in the war, her commander being ambitious to see plenty of fighting, and the experiences she has been through have not been tame at any time. The ship joined Admiral Sampson's fleet June 3, the same day the "Merrimac" was sunk in the mouth of Santiago harbor. June 5 with several other cruisers she engaged the Spanish fortifications, firing 120 shots from her 5-inch guns, as well as a great many from her six pounders. Later, she protected the "St. Louis" during the cable cutting at Guantanamo, and between that time and her return to New York she has had several brushes with the enemy. According to the present plans of the Government the "Yankee" will be sent with Admiral Watson's fleet to the coast of Spain.

Telephone Charges and Costs in Italy.

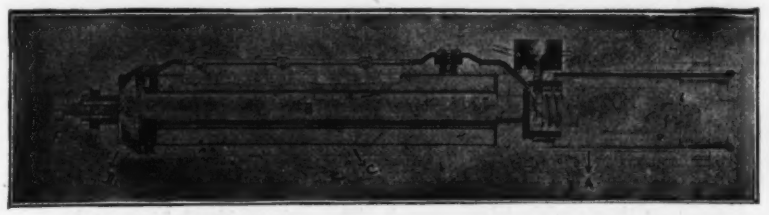
In an article in the London "Electrician" on "The Telephone in Italy," the tariff in Florence, where there are 900 subscribers, is given as the equivalent of $30 per annum within 1000 yards of the exchange, running up by steps as the distance increases. An interesting fact is that the switchboard operators receive a salary (?) of from $6 to $12 per month, working seven to eight hours per day. Linemen receive from 40 to 50 cents per day for ten hours' work, extra time being paid for at the rate of 4 cents per hour.

The Evolution of the Line Signal.*

BY ARTHUR VAUGHN ABBOTT.

Many forms of luminous signals have been suggested, but the only one in successful operation at present is the miniature incandescent lamp, which has, on the whole, proven itself of the greatest value. So far as the writer can ascertain, the idea of employing incandescent lamps for signal purposes arose with Mr. J. J. O'Connell, of the Chicago Telephone Company, who suggested in 1888 the employment of an incandescent lamp upon burglar alarm circuits in order to permit the legitimate occupant of a protected room to send to the alarm office an identification signal whereby his entrance to the premises could be made known.

In the latter part of the summer of 1890 some of the trunk lines in use in Chicago were provided with disconnect signals using miniature incandescent lamps. At the receiving office the trunk lines terminated in the ordinary cords and plugs used upon a telephone switchboard, in front of each of which an incandescent lamp was located. So long as the line was in use a relay in conjunction therewith was excited by battery current flowing over the line, and its armature drawn up. As soon as conversation was completed the operator at the originating office withdrew the plug from the trunk line jack at that office, thus opening the battery circuit and causing the relay to be de-energized; the release of the relay armature completed a local battery circuit, illuminating the incandescent lamp. The operator at the receiving office noticing the illumination of the lamp was thereby informed that conversation was completed and instructed to remove the trunk-line plug.



SECTION OF COMBINED RELAY AND LAMP.

COMBINED RELAY AND LAMP.

As the local lamp circuit was carried through the operator's listening key the placing of this key in the testing position extinguished the lamp. A very short experience served to demonstrate the superiority of incandescent lamps over any other form of signal, for the illuminated lamp was at once so positive and distinct as to instantly attract the attention of the operator, thus markedly accelerating switchboard work. As a result of this experience most of the trunk lines in the main office of the Chicago Telephone Company were rapidly supplied with lamp signals.

In the spring of 1893 it was proposed to re-equip a large multiple board in the Chicago exchange with self-restoring drops, but the expense and difficulty of this change caused the management to hesitate, and at this time the writer suggested the employment of incandescent lamps as subscribers' line signals on the ground of greater economy in space and in installation, as well as improved signal efficiency. More conservative telephonists doubted the wisdom of such a recommendation, fearing that the numerous relay contacts would be a perpetual source of trouble, and no further steps were taken with this project. In the winter of 1894 a new type of switchboard known as the "express board" was introduced. As this board was designed to meet the wants of metallic circuit subscribers, particularly those whose telephonic business was large, it was decided to provide incandescent lamp line signals. The circuit of this board was so arranged that, on the removal of the subscriber's receiver from its suspending hook, the movement of the hook closed the circuit and allowed battery current to flow through the line. This current actuated a relay at the exchange, in the local of which the signal was placed, situated behind a ground glass shade upon which the number of the subscriber was painted. The illumination of this disc displayed a very distinct and conspicuous signal that immediately attracted the operator's attention. Notwithstanding some apprehension as to the possibility of trouble with relay contacts the service given by the lamp signal was, on the whole, so satisfactory as immediately to concentrate telephonic atention upon the use of lamps, and within the four years that have since elapsed the superiority of the incandescent lamp for this purpose has been so fully demonstrated that nearly all of the large switchboards which are at present being constructed are completely supplied with signals of this description.

As the service to which the incandescent lamp when used as a signal is subjected is peculiar, the employment of lamps upon telephone switchboards has afforded lamp manufacturers a new problem. In the early experiments ordinary miniature lamps of low voltage were employed. As these lamps were bulky and consumed a large amount of current, the first attempts at improvement were directed to obtaining a smaller and more economical lamp. The early lamps were designed entirely to fit a socket supplied with a screw thread, and the conductor was supplied with a spiral spring, the pressure of which it was expected would lock the lamp in its place and constantly maintain good electrical contact. This expectation was not fulfilled, for one of the greatest troubles encountered has been the loosening of the lamp in its socket, due to the almost inappreciable jarring to which all buildings are subjected. Lamps in sockets of this description will gradually unscrew, opening the electrical circuit; they are then incapacitated as signals and considerable complaint will arise. The present lamp occupies no greater volume than that required by a spring jack and may be inserted into sockets composed of pairs of springs arranged on a rubber strip. Such sockets so closely resemble standard spring jacks that they are called "lamp jacks," for they occupy the same space, and may be secured in the switchboard in the same manner. By placing alternate strips of lamp sockets and jacks, the subscriber's line signal and answering jack may be more closely associated than has previously been possible, space economized in the switchboard and service accelerated.

At first it was considered desirable by lamp manufacturers to preserve a large volume in the bulb of the lamp in order to secure an adequate vacuum. To attain the desired compactness, the bulbs of the lamps are made small and long. The bulb is a glass tube about one-quarter inch in diameter and 1⅛ inches long. For four volt lamps a straight filament is used, but for all others a horseshoe shape. Only sufficient platinum is employed in the leading-in wire to pass through the glass, and in other respects the general details of manufacture correspond closely to the best practice in standard lamp construction. The base of the lamp is a bit of boxwood, so shaped as to readily enter the springs forming the socket, and arranged to prevent the lamp from turning as it is pushed into place. The earliest lamps were all designed for low-voltage circuits, rarely more than four volts. Presently it became apparent that lamps of longer life, together with an economy in conducting circuits, could easily be attained by the use of higher voltages, and the next advance was secured by making lamps for ten and twenty volts, while at present twelve and twenty-four-volt lamps are standard.

When first used as signals, the lamps were placed in the local of a relay actuated by current passing over the line to which the signal was attached. In the early attempts the ordinary telegraph relay was employed, armed with extra heavy platinum contacts to prevent burning. It seemed possible to obviate the expense of installing and maintaining this relay by an appropriate lamp directly in series with the subscriber's line, so placed that the removal of the telephone from its hook should close the circuit and light the lamp. This experiment was first tried in the Chicago express office and, on the whole, worked passably well, there being a comparatively small mortality of lamps due to short-circuits and other accidents. A continuation of this experiment was attempted in another office, but resulted disastrously, as the lamps were burned out so rapidly as to cause an excessive maintenance expense. The occasion of this failure is to be ascribed to a preponderance of aerial lines in the last case. A wind cross occurring near the office on a long line would subject the lamp to an abnormal

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voltage and either injure or immediately destroy it. In an express office, where the lines were chiefly underground, little or no trouble was experienced from this cause, and in an office in St. Louis, similarly equipped with lamp line signals placed directly in the subscriber's line, the use of a very heavy filament lamp obviated the difficulty experienced with injury to lamps. But while economy in installation due to the omission of the relay is eminently desirable, present experience decidedly indicates that the relay is essential to the successful lamp signal.

For this purpose rather an interesting type has been evolved in an attempt to consolidate the relay, lamp and socket into a single piece of apparatus and at once obtain a device which should be absolutely dust-proof and free from trunnion trouble. A general view and a section of this relay, which was developed largely with the assistance of Mr. M. A. Edson, of the Chicago Telephone Company, are shown herewith.

From the latter illustration it will be seen that the front end of the "lamp relay," as it is termed, consists of a brass tube *A*, forming the lamp socket, carrying the screw at the bottom, supplied with round glass cap, carrying the subscriber's number. From the rear of the socket extends a core *B*, of soft iron surrounded by an iron tube *C*, between which the winding space is obtained. A hemispherical brass cap *D* covers the end of the iron tube, retained in its place by an appropriate set screw. The inside of this cap is hollowed out, containing a piece of soft iron *E*, in the form of a frustrum of a cone, that constitutes the armature. As this piece of apparatus is set horizontally the armature rests upon its edge in an unstable position, tending to settle backward and rest against the back of the cap. The excitation of the windings magnetizes the core, and, attracting the armature, draws it up sharply. A thin platinum spring placed on the front face of the armature serves to make contact with a corresponding platinum point set in the centre of the core. As the core is insulated from everything but one lamp wire, while the other is connected to the cap, the excitation of the relay lights the lamp. By this device a relay was obtained, the moving parts of which were completely dust-proof. All trunnions or hinges were obviated and the armature merely resting upon a sharp edge secures a minimum amount of friction. Notwithstanding the compactness and completeness of this piece of apparatus, it has been found desirable to disassociate the relays and lamps, placing the relays in a case by themselves, away from the switchboard.

Probably the most gratifying feature in the evolution of the line signal has been the improvement in the life of miniature lamps. When the luminous signal was first proposed the question of cost of lamp renewals was at once raised. As each lamp was only illuminated for a few seconds at a time the service seemed equivalent to constant flashing, and ominous prophecies were plenty as to the short life to be expected. It was confidently asserted that such small lamps would either immediately burn out, or else so rapidly become dim as to be valueless as signals. Some tests were immediately instituted in the hope of eliciting information on these points. There was no question but that the candle power of the lamps gradually declined, and photometric measurements showed that when a lamp failed to emit at least 0.5 candle power it became of no value as a signal.

To determine the resistance to flashing, a number of lamps were connected in circuit with a clock pendulum and flashed at intervals one second for nearly a month, with no signs of serious injury. During this test the lamps were illuminated more than a million times, so it seemed certain that a reasonably long life could be expected. Experience has since shown this conclusion to be justified, for in the main office switchboard in Chicago, there are now lamps at work that have been in service for upward of three years and seem still to be in fairly good condition. Observation has further shown that accidental injuries, rather than old age, are the cause of most lamp failures.

Much delay was experienced in obtaining the first lot of switchboard lamps, so on reception they were immediately placed in service without inspection. The rapid failure of a large number of these caused no small degree of consternation and it was determined to initiate a systematic inspection. As a result all lamps are now examined: 1.—Mechanically, to see if they will fit the sockets. 2.—Electrically, to determine if they have the proper voltage and consume current within the specified limits. 3.—Optically, to ascertain if they emit the required candle power, and absorb the proper watts per candle. Also a certain number of lamps from each lot are placed on life test and burned to destruction.

The total cost of a luminous signal is evidently the cost of the lamp, plus the cost of current consumed during its life, and it is easy to show that this is a minimum when the cost of the energy consumed is equal to the cost of the lamp. Switchboard lamps now cost in the neighborhood of 45 cents each. With a life of, say, 2000 hours the cost of energy is about 60 cents, but it has been shown that accidental causes tend to reduce the actual life in the switchboard far below that shown by laboratory tests and it is doubtful if the average lamp lives for 1200 hours. Unless accidental destruction can be greatly reduced below the present amount, the cost of the lamp is now considerably above the cost of energy during its life and a still lower efficiency could profitably be employed, for it must be remembered that the thick heavy filament in the low-efficiency lamps is the best insurance against accidental injury. Theoretically, subscribers' line lamps should last twenty-five years; cord supervisory lamps from one to two years; trunk line lamps the same length of time, and pilot lamps from three to six months. Such a life as this has been obtained in the cord and pilot lamps, but it is doubtful if the theoretical limit for the line lamps will ever be closely approximated.

Even in the present probably only partially developed state of the luminous signal some 20,000 subscribers are now served upon boards thus equipped, and switchboards for as many more are in process of construction. Already the adoption of this form of signal has materially modified the arrangement and design of switchboard apparatus, and has been so efficient a factor in the improvement of telephonic service that it is difficult to prophesy the end of its effect.

Synchronizing Apparatus.

In an article on switchboard apparatus in "The Mechanical Engineer" (Manchester, England), Mr. J. R. Blaikie makes the following comments on synchronizing apparatus which may be of interest to electrical engineers in this country:

In alternating current stations this apparatus is of the first importance, and should be the object of the designer's special care and foresight. The possibility of a mistake on the part of the operator should be thoroughly investigated. The risk of breakdown in any part of the apparatus having been reduced to a minimum, provision should be made for replacing any defective detail within a minute or two, with no possible chance of reversing a connection, or there should be a simple method of throwing a spare set into circuit. There have been three or more methods suggested for synchronizing. First, two lamps, or one lamp and a voltmeter, in series, off the secondaries of two transformers in series, the primaries being one on each of the pair of leads required to be synchronized. Second, a similar arrangement, having a telephone or buzzer to indicate the flow of current through the secondaries. Third, gold-leaf electroscope, which can be used direct on 2000-volt mains. The first method is almost always employed, and it has the advantage of being easily seen by the driver, enabling him to adjust the speed of his engine. This information can also be obtained by lighting the station with alternating current arc lamps. When the armature is at the correct speed, the coil holders appear to be stationary, or revolve very slowly backward and forward as the speed is too high or too low. It might be almost worth while to switch on a lamp in broad daylight, when synchronizing, for this purpose. Where alternate current arc lighting is adopted a gold-leaf synchronizer could be used. It is more secure from breakdown for having no transformer. It is very dead-beat, but at present it has not been developed as a switchboard instrument, and requires modification to preserve the extremely high insulation necessary. While on the subject of synchronizing, it is instructive to notice that in English stations an artificial load on the incoming machine is considered unnecessary, although usually employed on the Continent.

In one English station it has been found advantageous to parallel machines through an impedance coil, and then short circuit the coil in two steps. As an extra precaution the paralleling of all machines up to 400-kw capacity is done through a 20-ampere fuse, and this fuse is not blown more than once a month. It may be mentioned that the armatures are of the coreless type.

Reduction to Practice.

It is always pleasant to hear a kind word from our English cousins. In referring to a certain work which is being done in this country in developing wireless telegraphy, a prominent English electrical journal says: "But to us the interest is more in the fact that America is taking up the subject, and will probably push it with characteristic energy to some practical purpose."

Underground Conductors.*

BY PROF. F. A. C. PERRINE.

The economical limit in the burying of wires is to be found in towns of such size that the number of wires for transmission purposes, installed in the streets, is not so great as to produce serious mutual interference, or interference with firemen or others whose work causes them to need a clear space above the street level. Simply the beautifying of a town will rarely compensate for the extra cost and difficulties encountered in underground construction, since the sight of the overhead wires does not become unbearable, until, at the same time, they are so numerous as to mutually interfere with each other.

Three general systems have been used for the installation of underground wires. The first and simplest is the "solid" or "built-in" system, where the wires, which are insulated thoroughly and thoroughly protected from mechanical disturbances, are buried in the ground. Secondly, we have the "draw-in and draw-out" systems. In these systems a passageway is provided underground for insulated cables, the passageways being simply tubular holes terminated at convenient distances by large underground working boxes or manholes—all connections of the cables being effected in the manholes, the cables themselves being drawn from manhole to manhole through the ducts, in which the cables loosely lie and from which they may be readily removed for repairs. The third, or "trench," system is an attempt to use the overhead construction in small closed trenches below the street level; the wires, which may be either bare or insulated, being supported on special forms of pins and insulators, thus reproducing underground the common form of overhead construction.

The simplest of the "built-in" systems are those in which each wire or cable is separately insulated and mechanically protected by some metallic covering in such a manner that it need not be feared that street disturbance will destroy the insulation. Across private grounds, where the cables may be laid and their location always indicated to workmen, this form of construction can be accomplished by the use of lead incasing pipes, provided only the lead be protected from the action of organic acids in the soil by means of a heavy coating of asphaltum held in place by a thick wrapping or braiding, but in public roads and through city streets such a method of wire installation would not be permissible, since the lead coating is not mechanically strong enough to resist even a slight amount of mechanical injury, and where independently protected cables are to be buried directly in the ground a heavier iron sheeting is then necessary.

This form of protection is accomplished in the Edison system by the use of iron pipes, and in the Siemens-Halske system by a double wrapping of iron tape. The Edison system of "built-in" conduits is especially adaptable to an extensive house-to-house distribution, on account of the fact that the lines are constructed in such short lengths as cast or wrought iron pipes may be made—namely, lengths not exceeding 25 feet. The form of conductor, insulation and protection here used is perhaps the cheapest that can be accomplished in any method, but as frequent joints must be made in the conductors and pipes, the final cost of the system is not low, unless from each joint there is a necessity for carrying away service wires, which is the condition encountered in a house-to-house distribution. The conductors used in this system are solid copper rods, either circular or semicircular in section, the circular conductors being used almost exclusively for the common three-wire Edison distribution systems. These copper rods are loosely wound with jute rope and slipped dry into the iron pipes, which are then filled with a hot compound of petroleum residuum and asphaltum, the filling being accomplished at a temperature sufficient to drive away most of the moisture contained in the jute rope, which finally becomes well saturated with the compound. These lengths of pipe are connected together with spheroidal junction boxes, made in two halves, allowing sufficient room for connections between the conductors, and provided with outlets, where it is contemplated to connect service wires. At important junction points large cast iron junction boxes are used, which permit the interconnection of the different circuits and admit of the introduction of fuses, which protect the main circuit from accidents occurring to sections of the service wires, and furthermore provide ready means for testing and fault location. This method was one of the very first practical systems of underground construction, and has given great satisfaction where the potentials are not higher than those commonly used on Edison three-wire circuits, although it is doubtful whether these cables would be satisfactory for higher potentials, since the method of filling the pipes does not admit of a thorough removal of moisture from the jute wrapping, and also it has been found impossible to thoroughly protect the ends of the pipes by any economical method, so that a small amount of water will penetrate the insulating material if any construction work is done during bad weather.

For trunk mains and long feeders the Siemens-Halske system of iron-taped cables is more satisfactory, as these cables can be made in continuous lengths of 500 or 600 feet, although lengths as great as these are exceedingly difficult to handle, on account of their weight. In this system, as the iron taping is not entirely impervious to moisture, the insulated cables are lead-cased, the iron taping being applied over a bedding of jute, and further protected exteriorly by a wrapping thoroughly saturated with an asphaltum compound similar to that employed for the protection of submarine cables.

At various times other solid systems have been contemplated; underground cables being sometimes laid in wood trenches, which are subsequently filled with melted asphaltum. A few attempts have also been made at installing copper rods or pipes, insulated entirely by means of the asphaltum with which the trenches were filled, but it is found in practice that asphaltum does not resist the penetration of moisture, especially as this material has a high coefficiency of expansion with temperature, and in consequence during cold weather cracks occur, while in warm weather the material is not sufficiently strong to maintain the conductors in their proper relative position, unless they are supported in the trenches on wood balks. These balks cannot be so thoroughly saturated with any compound that they will not subsequently absorb moisture and short-circuit the system. At one time the Calender Insulated Wire Company installed a large amount of cable, insulated with a compound of rubber and asphaltum which was partially vulcanized, the cables being supported on wood balks and the trenches filled with asphaltum; but even here the conductors sank into contact with the balks and short-circuiting ultimately took place. These difficulties might be overcome by installing rubber-covered cables suspended by a jute wrapping from iron wires parallel to them and carried on insulating balks, and if the trench in which these cables were carried should be filled with asphaltum the construction would doubtless give great permanence, but the supreme difficulty with any such system is encountered when repairs or extensions are contemplated, since no cable of the system can be removed without disturbing all the cables in the trench, and in spite of the fact that such a built-in system is without doubt more economical to install than any other, this disadvantage has prevented the possibility of an entire solution of the insulation difficulties in solid systems being attempted.

Intermediate between the draw-in and draw-out systems lies a method of construction designed by David Brooks, which has been employed to a greater or less extent since its first conception, in about 1881. Brooks desired to employ oil as an insulation for cables, as he had found that wires insulated with rosin oil were exceedingly difficult to short circuit, even under the influences of high values of potential; but, of course, no pure oil could be used in the construction of a cable, even were it lead-incased, for opening the lead casing while joining would allow the escape of the oil. The method which he proposed, therefore, consisted of laying an iron pipe line over the whole distance to be traversed, in which the pipes were terminated by hermetically sealed boxes—the cables to be drawn into these pipes being lightly wrapped with jute, and, after being boiled in oil, were drawn into the iron ducts, which then remained full of oil. In order that leaks in the pipe should not admit small amounts of moisture where the pipe was laid through damp ground, Brooks proposed having the oil in the pipes under pressure from a standpipe or pump, the theory being that small leaks would allow the oil to escape and on account of the pressure behind the oil no water would enter. However, this principle was not found to be operative on account of the fact that exceedingly heavy oils were necessarily employed for obtaining the best values of insulation. and in these oils the pressure from the standpipe or pump could not be transmitted over a considerable distance when there was movement of the oil column, on account of the friction between it and the pipes with their inclosed cables.

*Abstracted from article in "Electrical Engineering," July, 1898.

In this country there are not at present any examples of the Brooks method of construction, although at one time extensive experiments were made by the Western Union Telegraph Company and the Pennsylvania Railroad Company between Jersey City and Newark, across the marshes. But in England the system has been developed by Messrs. Johnson & Phillips, who have succeeded in obtaining a highly satisfactory system by abandoning the principle of oil under pressure and paying great attention to the details of the laying of pipes without leaks and hermetically sealing all junction boxes and pipe ends. For certain classes of work, as for electrical lines traversing private grounds, and for long trunk cables, where there is not much probability of cables ever being disturbed after they are laid, this system presents many advantages, although when the construction is satisfactorily done the cost is not materially less than with other plans which might easily be adopted in its place, but where the cables must be disturbed either for repairs, extensions or subsidiary connections this system meets with many disadvantages. In the first place, handling the cables, which have been saturated with a heavy oil, such as rosin oil, is extremely objectionable to the workmen, who are thus not able to take the same pains with their work as would be possible when working with comparatively clean hands; and furthermore, where a little oil has leaked out of the pipe after it is cut for introducing a new junction box, it is exceedingly difficult to fill the pipe again without removing the entire length of cable and refilling just as if new cable were being installed. These disadvantages, increasing the cost for repairs, cause the system to be uneconomical in operation, and to sacrifice whatever advantages of cheapness it may have in the original installation.

The largest installations of insulating ducts have been constructed on the systems of Dorset and of the Interior Conduit Company. Dorset's plan never contemplated the installation of cables entirely without insulation, although at the time it was first used it was hoped that the character of the duct system would materially reduce the cost of covering the cables themselves. This conduit consisted of blocks of asphaltic concrete moulded in lengths of about 4 feet, the cross section being 1 foot square, each block pierced from end to end by a series of duct holes 2½ inches in diameter, formed by mandrels, around which the blocks of asphalt were cast. These lines of conduit were laid with abutting ends, and, after being held in alignment by mandrels in the duct holes, were cemented together by hot pitch poured between the sections of conduit. This is a system of construction which, largely used in New York and Minneapolis, proved to be a complete failure on account of the fact that it was impossible to be sure that the pitch between the sections of conduit effected a thorough cementing, and in consequence, after construction, the blocks were found to have cracked apart and fallen out of alignment, thus not only sacrificing all the insulating properties of the conduit, but reducing the size of the ducts, on account of the holes in the different sections not being strictly in the same straight line.

General Weber, of the British Postal Telegraph, has modified this system until he has been able to construct a satisfactory cable-carrying conduit with its use, although he has never been able to render the conduit entirely impervious to moisture, and in consequence where it is used by him it has been employed without much reference to its insulating properties. Weber's modification of the Dorset system consists in laying the sections of moulded conduit with a space of 4 or 5 inches between them, into which melted material of the same constituents as that of the original conduit is poured. This melts back the moulded portions for a short distance, and produces a conduit entirely homogeneous and satisfactory as a cable duct, although not admissible for the employment of uninsulated wires.

The system attempted by the Interior Conduit Company was installed for the feeders of the street railroad at Minneapolis, and consisted of paper tubes thoroughly impregnated with petroleum residuum, laid in a trench, with paper ferules at their joints, the whole trench being filled with asphaltic concrete, composed of residuum, asphaltum and coal tar, poured hot into the trenches and entirely covering the paper ducts. Into these paper ducts a bare copper strand was drawn, small manholes being provided at the feeding points, which consisted of double wooden boxes, sealed by compound poured between them and covered with water-tight covers. After a couple of years of fairly satisfactory work it was found necessary to abandon this construction, although it is probable that the failure was largely due to the original use of unsatisfactory materials. The paper ducts themselves were not thoroughly impervious to moisture, and being supported on wood balks to prevent their sinking through the compound with which the trench was filled, these wooden balks became saturated with moisture and short circuited the cables through the paper of the conduit tubes. Furthermore, the manhole construction was not thoroughly water-tight, and in many instances the whole duct system was found to be filled with water after heavy storms. Profiting by the experience gained in this construction, the Interior Conduit Company has proposed a similar system with a number of paper tubes, telescoped one within the other, and designed to be laid with broken joints, the exterior surface of the tubes being protected either by an iron pipe or laid as before, in asphaltic concrete, and supported on blocks made of pottery, thoroughly water-tight iron manholes being designed in place of the double wooden boxes.

The latest system of insulated ducts is that of Cummings, in which large iron pipes are employed for inclosing a number of ducts, four wooden ducts being inclosed in each pipe, the space between being filled in with an asphaltic compound. This system has found a limited use for low-pressure construction, where but a small number of cables are to be installed, and will not probably find wider application, on account of the fact that it is doubtful whether such construction is less expensive than a multiple duct system, where many cables are used and connections or repairs are frequent.

In consequence of the ease with which repairs may be effected in the "draw-in and draw-out" systems, these have come to be considered as the standard method of installation for underground lines throughout the United States. When first contemplated it was thought that the cost of the total system might be decreased by providing an insulating conduit, into which conductors lightly insulated might be drawn, or even in special cases uninsulated wires might be laid; but all attempts at such construction have resulted in failure, since, as has been said, it was found impossible to construct a conduit that would afford of itself insulation sufficiently high in value when laid under the conditions in which street work must be accomplished. Even where a good insulating material has been used for the ducts, the relative differences of temperature between the external atmosphere and that of the ducts has caused heavy condensation of moisture within the ducts themselves; and furthermore, it has been found generally impossible so thoroughly to seal the manholes as to entirely prevent the entrance of storm water. In addition no insulating duct has yet been found which can be constructed with sections of great length, and the difficulties of laying the ducts in short lengths with perfect alignment have not been overcome. In consequence, engineers have decided that an underground duct system can only be called upon to fulfill the following requirements:

First, the ducts should be internally smooth and free from projections, so that the lengths of cable may be easily introduced and at any time withdrawn.

Second, the ducts should be reasonably water and gas tight, even though no attempt at effecting an absolutely hermetically sealed duct has ever been successful.

Third, the duct construction must be sufficiently strong to withstand both the surface street traffic and accidental interference when other street work is in progress.

These conditions have been filled by ducts made of wood, iron, terra cotta and cement, a choice of the particular duct to be used depending upon the weight of the street traffic, the chances of interference from other workmen, and finally the cost per cable in the different localities. The materials used for these ducts might be divided into insulating, semi-insulating and metallic; but, as the insulating properties of ducts are not now considered of importance, such subdivision would have no significant character. For wooden ducts use has been made of planks, with semicircular grooves, so laid together that two planks make a conduit; or they have been constructed of independent pump logs, and where care is taken in thoroughly seasoning the lumber and subsequently impregnating it with an antiseptic compound, this construction is satisfactory, especially since no duct material offers less resistance to the drawing in and drawing out of the cables, and in no other form of construction can so great lengths of heavy cable be used. As a consequence many miles of properly prepared wood ducts are in use, giving satisfaction; but when the removal of the sap from the wood and its subsequent impregnation with a preservative compound is done imperfectly, the natural wood acids and the acids which form as the wood decays are found to be very injurious to the rubber of insulation, if rubber-covered wires are used, or to the lead covering when

lead-incased cables are employed. Indeed, in this form of duct, lead-incased cables are destroyed very rapidly, the lead being transformed, by the acetic acid from the wood and the carbonic acid which is always present in the air of a city, into lead carbonate or white lead. It was at one time thought that this action was due to the creosote commonly employed in wood preservation, but careful experiments have proved that where the wood was thoroughly dry and freed from every acid, and where the impregnation was honestly done with "dead oil" or creosote obtained from coal tar, and not with wood-tar creosote, no such action took place, and in them the cables have as long a life as in any other form of duct.

The strongest of all conduit systems is the one which is most commonly used in larger cities, where the surface traffic is heavy and street disturbance frequent. This consists of wrought iron pipes laid on a bed of concrete. The common form of 2-inch steam pipe is most commonly employed, connected by ferules with a taper thread, according to the ordinary methods of steamfitters. These pipes are laid in horizontal rows on a 4-inch bedding of cement, about 1½ inches apart, and as many tiers of pipe rows as is necessary for the duct system, laid one above the other, the concrete being well pounded in between the ducts. Over the top of the final row of pipes a 4-inch layer of concrete is laid, and the whole finally protected by a planking. This form of construction leaves nothing to be desired as regards durability, although it is necessary that great care be taken in the inspection of the pipes, that no internal burs remain from the welded seam or from cutting and laying the pipes. In cutting, the greatest care must be taken that a flange is not turned up on the end, since any internal bur would be likely to injure the insulation of the cables as they are drawn in; and, furthermore, the flange left by the pipecutter is apt to diminish the area of the duct.

This system is one which is exceedingly expensive, and in consequence various attempts have been made to produce a concrete duct without the use of iron pipe, since if a strong concrete be employed the iron pipe can be regarded simply as a former for obtaining a truly cylindrical hole. Zinc tubes were first proposed for effecting this, but it was found that in handling the zinc was apt to become dented and reduce the area of the tube. The Chenoweth system contemplates the formation of a cement tube by ramming the concrete around a mandrel wrapped with a metallic tape, which may be subsequently withdrawn by first slipping out the tapered mandrel and then withdrawing the spiral of tape; but no great success has been obtained by this system, since if the ducts be made thoroughly smooth the expense of construction is not materially less than where iron pipes are employed.

Cement-lined iron pipe, however, has been found to surmount all these difficulties.

Cement-lined iron pipe consists of sections of thin wrought iron pipe 8 feet long, with a riveted seam, lined with five-eighths inch of pure Rosendale cement, without sand, moulded within the iron pipe by placing in it a brass pipe the size of the desired duct, and pouring the cement into the surrounding annular space, the brass pipe being readily withdrawn after the cement has slightly hardened. The sections of this duct are connected by moulding in the cement an external and internal joint of spherical form, so that a considerable amount of change in direction between two sections is permitted without throwing the ducts out of alignment—the external and internal joints fitting each other on the ball-and-socket principle. This form of conduit is laid in a bed of concrete, exactly as has been described for the iron ducts, the construction being designed to take the place of the iron ducts, with the advantage that the construction is cheaper and the ducts are internally smoother, so that a greater length of cable may be drawn into the ducts at one time without an unnecessarily heavy tension being applied to the cable ends. It is also claimed for this conduit that the cement can have no effect upon the insulation or the lead of cables drawn in, but use has not indicated that the system has any advantage in these respects over an iron pipe, since whatever effect of corrosion may take place on the insulation or the lead of the cable covering is due rather to corrosive principles present in the water, which may filter in or condense within the ducts themselves, and protection from this effect is now so well understood that such corrosion is not to be feared in any satisfactory system of duct construction.

The telephone companies throughout the country employ a very large amount of conduit made with terra cotta ducts. The first system of this kind was that of the Lake conduit, originally used in Washington, D. C. The Lake conduit is made of glazed earthenware about 1 inch thick, with two or four rectangular ducts, each 3 by 4 inches, the lengths of the sections of conduit being not over 4 feet. These lengths are laid with abutting ends and served with wrapping or burlaps, which is then impregnated with hot asphaltum, care being taken that the temperature of the asphaltum is not so great as to destroy the strength of the burlaps. These ducts are then laid upon a bedding of concrete and protected at the sides and over the top by concrete, liquid cement being poured in between the various parallel sections of conduit, in order to cement the whole into a solid mass. This makes a duct which is internally very smooth, and into which cables may readily be drawn, although on account of the large size of the ducts it is uneconomical to lay but one cable in a duct, which at times necessarily interferes with the ready withdrawal of single cables for repairs. In this construction the McRoy conduit has succeeded the Lake, being constructed of better materials and more carefully, so that it is stronger, smoother and more impervious to water.

The most recent improvement in this system consists in the use of a single duct of terra cotta or hollow tile. These hollow tiles are made of earthenware, square in cross section, from 18 inches to 2 feet long, pierced by a duct about 2½ inches in diameter, with an internal and external shoulder at the opposite ends for joining the different pieces of tile and keeping them in perfect alignment. This system is laid on a bed of concrete, the separate tiles being laid up in cement, making a solid tiling wall, and the construction is found to have the great advantage of internal smoothness, together with the advantage of having a separate duct for each cable, which is not possessed by the Lake construction, although for the same number of cables it is slightly more expensive than the rectangular earthenware pipe. In any system where terra cotta is used it is necessary to avoid easily fusible materials containing a large proportion of sodium, since such materials are readily decomposed by escaping currents producing metallic sodium, which may cause gas explosions in the ducts.

It has been already stated that while attention might be paid to the relative insulating properties of these various conduits, at the same time this property does not determine the character of the cable to be employed. It has, however, been found that this insulating property must be considered in all service, for when a metallic duct is used and a cable is defective at any point, the cable is immediately grounded where it is defective; but where ducts of cement, terra cotta or wood are employed the cable is not well grounded in every part, and in consequence difficulties are sometimes encountered with lead-incased cables grounding on each other, rather than through the ducts, causing the destruction of good cables where they touch defective cables, unless care is taken to solidly connect the lead sheathing of each cable with some form of ground at frequent intervals.

In all underground systems it is necessary to provide boxes or vaults for the making of connections between cables and for the attachment of feeders. Even trunk cables cannot be handled in lengths greater than 1000 feet, drawn into the duct 500 feet in either direction from a centre, and in consequence all duct systems must be made accessible at distances not greater than 500 feet apart. These frequent points of accessibility are not absolutely necessary in the built-in construction, although it is difficult to handle lead-incased cables in lengths much greater than 1000 feet, except for the smallest cables, since the weights of longer lengths prove to be sufficient for the upper layers to crush the insulation of the underlying layers on shipping reels. Where solid or built-in systems are employed points of accessibility are provided in small junction boxes, containing a system of contacts which may be interconnected in any desired manner by wires or fusible strips, the junction boxes themselves being made small and thoroughly water-tight, the common form being that of iron boxes cast in a single piece, with a lid made tight by a gasket. As this form of construction contemplates only one system of cables in each junction box, the various cables of the system being interconnected merely by uninsulated conductors, there is no necessity for the junction box to be larger than will be required by the presence of the conductors—the workman making a change never being required to enter the box itself. Several forms of such junction boxes have been developed, but those systems which are most complete are the ones adapted to the Edison and Siemens-Halske underground systems.

In the draw-in and draw-out systems larger junction boxes must be provided, since in general the ducts of these systems are far below the street level, and in consequence the splicing of the cables must be done by a workman standing within the junction box itself. These are then called "splicing vaults" or "manholes." The size of a splicing vault depends largely upon the depth of the conduit. In certain localities where the ground does not freeze to a great depth during the winter and where the traffic is light, it is possible to lay the conduits at a shallow depth and near the curbs, or under the sidewalks. When this is possible, it is easily seen that the presence of workmen on the streets splicing cables is not so objectionable as where the work must be done in the centre of the streets. Accordingly, for this class of construction the splicing vaults are made small and called "handholes," as, for example, where the ducts are laid about 2 feet below the street surface, handholes 4 feet square by 4 feet deep are found to be sufficient, the workman splicing the cable sitting on the street with his legs hanging into the handhole, splicing with the cable in his lap; but where this shallow construction is not possible the splicing must be done at the bottom of the hole, and for this reason the splicing vault must be large enough for the splicer to work rapidly and without interference with neighboring cables, the size of the vault depending somewhat on the number of cables and upon their character, although a splicing vault should never be less than 4 feet square, from which size they increase to 8 feet square in some of the larger systems.

Even where but few cables are to be installed a splicing vault 4 feet square is found to be an inconvenient place in which to work, and where three or four ducts lead into the vault they are rarely made less than 5 feet square—6 feet being considered the standard size in the larger cities. The depth, of course, depends upon the depth of the ducts, although the floor of the splicing vault should always be at least 18 inches below the lowest cable ducts, on account of the convenience of the workmen, who should not be obliged to work in an exceedingly uncomfortable position, and on account of the fact that these splicing vaults form catchbasins for any water which finds its way into the conduit system, the ducts being generally laid with a grade toward the splicing vaults. If a good depth of vault below the lowest duct is provided, then any moderate amount of water accumulating within the system will lie harmlessly in the bottom of the vaults, and can easily be removed by pumping. Where the ducts are on a line with the bottom of the splicing vaults the cables will often lie in water, and the deterioration of their covering is hastened.

Cast iron splicing vaults have been proposed and are used to a limited extent where small vaults are required, but there is no special advantage in the employment of cast iron, since it is found to be very difficult to make these cast iron boxes thoroughly gas and water tight at the points where the cable ducts enter. Accordingly, the common construction consists of a brick wall laid upon a concrete floor, the brick being laid in cement and coated internally with a plaster of cement. Such a form of floor is penetrated by dampness, but a large amount of water cannot pass through the walls, nor are the walls extremely permeable to gases. In any system, therefore, the size of splicing vault should be as great as a reasonable cost of construction will allow, although an excessive size increases the cost of cable laying, for the cables cannot be carried straight across the vaults from duct to duct, but must follow the walls and be hung upon hooks set in the brickwork, in order that each cable may be readily accessible for renewals or repairs; and where very large vaults are provided there is a waste of cable, increasing resistance and cost, as the cable is carried around the walls.

At one time it was thought possible to splice all cables on the street, without reference to the depth of the ducts, the cables of different ducts being both carried up to the street level, and spliced in a head, which was then fastened to the side wall of the ducts; but not only did this form of construction increase the length of useless cable, but also such "heads" formed convenient steps for workmen entering the splicing vaults, and where the vaults were frequently entered the cables were soon injured by being used in this improper manner. Often where the cables are carried around the side walls there is a great temptation for workmen to use them in entering and leaving the vaults, unless they are so located that they are inconvenient for this purpose, and in consequence they should be so placed where it is possible; the manhole for entering the vault being on one side of smaller vaults, or in the center of large vaults, so that a man cannot readily let himself down through the manhole and rest his feet on the cables.

The two great difficulties found in underground construction arise from the presence of water and gas within the ducts. Water may enter either from condensation of moisture from air which is admitted whenever the construction is opened, or from overflowing of the streets where the manhole covers are not thoroughly tight. Gas penetrates the conduits through the walls of the splicing vaults, and even through the ducts themselves when there are gas leaks in the neighborhood. In the oldest cities such gas leaks are almost always present, and it has been found to be practically impossible to keep the ducts entirely free from its presence. There is a difference of opinion among engineers as to the best methods of removing these difficulties. In New York, where both water and gas have given a great deal of trouble, it has been found necessary to connect splicing vaults throughout the territory where gas leaks are plentiful by 6-inch pipes, through which a current of air is continually blown. Storm water is kept out by the use of perfectly tight manhole covers, and as it is impracticable to securely fasten the covers on the street level, where they are continually subjected to vibrations by the traffic passing over them, double manhole covers are employed, the inner cover being seated on a gasket and screwed tightly in place, while the outer cover is held down simply by its own weight, which in these cases amounts to 300 or 400 pounds.

When a tight conduit construction of this kind is employed and an air pressure kept on the inside of the ducts by blowing through the 6-inch pipe, gas does not seriously enter, nor is there trouble from storm water, while the water of condensation is continually removed by the blast of air, which serves the double purpose of keeping the ducts free from gas and moisture; but as this entails a considerable expense, both for the original laying of the ventilating pipe and for the operation of the blowing system, it cannot be contemplated except where a large number of ducts are laid and where the difficulties from water and gas are serious. Small amounts of gas are readily removed, either by ventilation through the manhole covers themselves, or by means of auxiliary pipes, led up to the tops of neighboring buildings. Such pipes have sometimes been attached to neighboring arc light poles, but this is at the present time considered to be a source of danger, for the gas within the duct may be ignited by the arc whenever an explosive compound flows out through the ventilating pipe.

In Chicago it is found that single heavy manhole covers, pierced with holes, afford ventilation and prevent the presence in the ducts of an excessive amount of gas, although many engineers hold that this is again a source of danger, on account of the possibility of gas coming out through the covers and being ignited by means of lighted cigars falling upon the covers. Indeed, no form of a ventilated duct seems to free the construction so completely from gas that it is safe for workmen to enter the splicing vaults until the gas has been well pumped out by means of a hand blower, and in such ducts it is generally necessary to continually force into the vault a supply of fresh air for the workmen whenever there is a likelihood of a large amount of gas being present.

On account of the great expense of construction of the splicing vaults in the draw-in and draw-out systems, auxiliary cable ducts must be laid for house-to-house feeding systems. These auxiliary duct systems contain only a few ducts, and are provided with handholes at every alternate house; the form of conduit construction which has been found to be most satisfactory for this purpose being a cast iron duct made in two halves, containing from six to eight separate ducts, the conduit itself being laid in sections of about 6 feet, the halves cemented together by plumbers' putty, and cast iron manholes being placed at every junction point.

In this country the only systems that have been satisfactorily employed are the solid constructions of Edison and Siemens, in which the cables are each inclosed in their own protection, and the draw-in and draw-out systems with auxiliary ducts for service; but in England and on the Continent wires have been satisfactorily laid in trenches, the attempt being to apply the principles of overhead construction in inclosed trenches underground. The most satisfactory construction of this character is that developed in England by Crompton, who provides a water-tight trench laid as near as possible to the surface of the street, the wires being supported on insulators located about 20 yards apart and made accessible by handholes. In order that spans of 20 yards can be allowed and the expense of tying the conductors to the insulators be not too great,

at points about 200 yards apart the conductors are firmly held by clamps, into which they are fastened after the conductors are strained until they hang at a safe distance above the bottom of the conduit. In this system no auxiliary service conduits are necessary, since all service wires may be connected at the handholes.

On the Continent a similar construction has been adopted, but the straining of the conductors has not been attempted, and in consequence they are necessarily supported at more frequent intervals. In Crompton's construction the supports are glass insulators held in wood balks, which are set into the concrete of the trench, while the Continental system employs balks made of pottery. These have been found to give trouble from the fact that no petticoat is provided for the pottery balks, and furthermore, the character of the pottery is such that on account of the porous material used they become saturated with moisture; and it is further stated that the escape of current has in some cases formed a deposit of sodium, which ignites in the presence of moisture and causes gas explosions. Such excessive leaks and gas explosions have not been encountered in Crompton's system, which has stood the test of severe service and potentials up to 500 or 1000 volts.

In America the smaller towns have not as yet demanded underground construction where a house-to-house distribution is contemplated, merely the trunk lines and feeders being buried, which can be done cheaply with insulating cables laid in wood ducts, and in consequence the trench system has not as yet found a foothold here, but with the extension of electric lighting and power plants it certainly seems that this form of construction should be more carefully considered, as it is especially adaptable in those cities where frost does not penetrate to a great depth, and where the weight of the surface traffic is not likely to injure the trench construction, especially since in such cities it is difficult to obtain workmen who are capable of satisfactorily splicing insulated cables and making connections to surface wires. The particular form of trench construction and the insulators employed by Crompton are those which are adapted to the materials to be had in England, and in consequence the employment of the Crompton system would not always lead to the cheapest form of trench to be used in this country, since the materials available for trenches and insulators will necessarily vary with the localities, while the character of the trench itself will vary with the character of the soil in which it is laid and the difficulties to be encountered from the probable presence of other underground construction, as well as with the street traffic which must be borne.

It is seen, therefore, that we have up to the present time developed very thoroughly a satisfactory system of underground construction for the larger cities, although we have not as yet attacked the problem of underground work and house-to-house distribution in the secondary towns. These points must carefully be borne in mind in comparing the work which is considered as standard in this country with the various systems which have been satisfactorily employed abroad, and as the laying of wires underground shall proceed it is not safe to presume that we have as yet exhausted the possibilities of satisfactory service with economical construction, for it is probable that in some cases built-in systems can be developed and in others that insulated conduits may be employed, and that in some cases the best service could be obtained by the use of a form of trench.

Lightning and Lightning Arresters.

BY H. E. RAYMOND.

Having had a number of communications regarding the use of an overhead barbed wire for protection against what I termed a "direct stroke," I think I may be justified in making my meaning more clear. Endeavoring to cut down the article on lightning and lightning arresters* into as small a space as possible I allowed a number of ideas to be taken for granted, and in this case seem to have incurred a general misconception.

In my experience I have known but few cases where a line was struck by a "thunder bolt." The first and second split up the poles, and in one case burned out an armature, while the third blew an arrester, installed on a pole, all to pieces, tearing down wire and a piece of the pole. It must not be imagined that by the term "direct stroke" I meant such instances. It was used more to distinguish, from inductive charges, gradual charging, etc., the effect on an electric line of a severe local discharge. If we refer to the accompanying figure it will be seen that a discharge often consists of main paths, with a large number of branch-like side flashes, while furthermore the space between is frequently affected by a brush-like or diffused electrostatic condition. Suppose our line ran in the neighborhood of A, B or C. It would then be influenced by the discharge in the main path or the direct stroke, and the severity of this influence would depend on the intensity and proximity of this stroke. If it should lie in the positions a, b or c it would be affected only by the minor flashes or the brush-like discharge. Both the action of arresters on a line, and the view of the lightning discharge show a much greater apparent volume in this direct path than in the side flashes. I have watched different forms of arresters in action on a dead line—i. e., with no dynamo current flowing. The discharge through them was by no means unvarying. While many forms acted alike at the same discharge the nature of the discharges was very variable. When the lines were affected by an induced charge the spark was small and the snap light; when a heavy discharge took place near them, the report and flash through the arresters was like that of a rifle.

A proper installation of arresters with a low striking potential

will generally be reliable for protection from the discharges from the side flashes, the induced charges, the gathering of static electricity from the atmosphere, winds, etc., but it would require an enormous installation of station and line arresters to adequately protect any system from the effects of a very heavy "main path" discharge in close proximity to the line. As I opposed the idea of a large number of line arresters, on a transmission line, I advocate the use of the overhead grounded wire as an auxiliary protection from these direct strokes. The wire will not prove a complete protection in itself, but it will and does tend to lessen the "volume" of the severe discharges and thus enable the arresters to discharge from the line proper what consists, then, almost entirely of an electrostatic charge without appreciable volume. It is the apparent volume we wish to take care of.

*THE ELECTRICAL WORLD, June 11 and June 25, 1898.

A Simple Method of Renewing Dry Batteries.

To renew an ordinary commercial dry battery when exhausted it is only necessary to perforate the sides and bottom with a dozen or more holes, the simplest method of accomplishing this being with the aid of a steel wire nail and a hammer. The battery should then be placed in a vessel containing water, and it will be ready for almost immediate use with a new life as long or longer than that already obtained. In renewing a battery of such cells they should not, of course, be placed in the same vessel of water, as the shell of the battery is one electrode, unless all the cells are placed in multiple. In case they are in series connection they should be placed in separate vessels, and if the latter are metallic they should be insulated from each other.

DIGEST
OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

AGING OF TRANSFORMER IRON. Klinker. Lond. "Elec.," June 24.—A short note referring to Roget's recent paper (see "Digest," July 2). He confirmed the discovery that at a certain temperature the iron commences to improve after having aged. He has made an extensive series of aging tests on different kinds of iron; in one a sample of Swedish iron was placed in an oven at 90° C.; its initial hysteresis loss was 0.15 watt per pound at 2500 lines per sq. cm. and 100 cycles per second; this was the lowest figure he ever found; after twenty-six days at this temperature the hysteresis loss became 0.31 watt per pound; after seven days at 120° C. the hysteresis loss was 0.19.

EXCITATION FROM HALF THE DYNAMO VOLTAGE. Sengel. "Zeit. fuer Elek.," June 19.—A brief abstract of a paper read before the Union of German Elec. Engs. A continuous-current machine is provided with a ring contact which is connected to one point of the armature winding, and is provided with a brush for leading off the alternating current; if the field is connected between that brush and one of the other two on the commutator, then only the rectified component of this current will act on the field magnet coils to excite it; the reverse current will be negligibly small, owing to the large self-induction of the field coil; these coils are therefore excited by half the voltage of the dynamo, and this is said to have some advantages in practice.

CRANE AND ELEVATOR MOTORS.—"Elec. Eng.," June 23.—A brief, illustrated description of the Westinghouse motors for these purposes.

Lights and Lighting.

ARC LAMPS. Richard. "L'Eclairage Elec.," June 18.—Brief but well illustrated descriptions of improvements in arc lamps, taken from patent specifications.

ARC LAMP.—Lond. "Elec. Eng.," June 24.—An illustrated description of the Cotsworth lamp.

STREET ILLUMINATION. Hopkins. "Elec. Eng.," June 30.—A short, illustrated article enumerating the requirements of satisfactory lighting. In a table he shows from an actual case how many of the gas and naphtha lamps were extinguished by wind while the arc lamps kept burning. A diagram shows, in the form of circles, the relative light-producing power obtained for $100 by the arc light and by gas and naphtha burners. He recommends that the present arc lights be sub-divided into three or four smaller ones, and predicts that the tower system will soon go out of use.

Power.

POWER DISTRIBUTION PLANT NEAR PRAGUE. "Elek. Zeit.," June 23.—A long, well illustrated description of the power plant at the Government Railway Works at Laun; all the power is supplied electrically. The power machine is a three-phase alternator, and the motors connected with it are largely those which are started and stopped frequently and must have a large starting torque; a well illustrated description of this alternator is given, including curves and working drawings with dimensions. Among the applications are a traveling crane, a traveling platform for locomotives, an elevator, etc., all of which are illustrated. The machinery was designed by Kolben.

STEAM-USING PLANT.—Lond. "Elec.," June 24.—A reprint of the discussion of Jeckells' paper.

FURNACE FOR BURNING REFUSE.—"St. R'y Jour.," July.—The burning of ordinary town refuse and garbage for generating power has been employed to a considerable extent in England with satisfactory results, the fuel, of course, costing nothing. Such a furnace is described and illustrated, the chief feature consisting in the use of forced draft, provided by steam jets, in which superheated steam is used. Some tests made at Rochdale, England, show the total water evaporated from 212° Fahr. was 1 pound of water to 1.97 pounds of refuse, the steam pressure being 8 atmospheres.

POWER TRANSMISSION ON WARSHIPS. Dickie. "Cassier's Mag.," July.—A long abstract of his recent paper before the American Society of Mech. Engs., in which he compares steam, water, compressed air and electricity, favoring the latter and claiming that every function requiring power on a warship can be performed by electric motors without involving the use of anything except well-known and tried mechanism.

Traction.

HALIFAX.—Lond. "Elec. Rev.," June 24.—A long, illustrated description of this municipal line, which has just been started, and which is said to be the first combined lighting and tramway system in that country in which the plant is controlled entirely by the municipality; work on similar lines is being carried out at Glasgow, Hull, Bradford and Plymouth. The streets appear to be extremely hilly; the single generator is driven by ropes; the lighting plant is run with alternating currents; a motor-alternator is to be added, and will consist of a continuous-current machine driven by ropes from an alternating-current motor; there is also a battery of 270 accumulators, having a discharge of 200 amperes for six hours; it is to act as a fly wheel, is to run the whole tramway during the peak of the lightning load and during the early morning hours, and by reversing the motor-alternator it will run the alternating current lights during the hours of light load; thus the alternating plant may be shut down during the night.

MONTPELLIER.—"L'Eclairage Elec.," June 18.—A brief description of the electric railway.

NO TROLLEY CARS IN LONDON.—Lond. "Elec.," June 24.—A note stating that the London County Council has vetoed every proposed introduction of the trolley system within the area which it controls.

ELECTRIC TRACTION. Stewart. Lond. "Elec. Rev.," June 24.—A reprint of a short paper read before the Municipal Electrical Association. It is directed more to the managers than to the engineers. He recommends that current should be supplied from the existing lighting station; he advocates municipal ownership. A table is given for three small and three large stations, showing that they could afford to sell the required number of units at 3.48 cents per unit and make a profit of 1 cent per unit by the transaction.

ELECTRIC TRACTION. Quin. Lond. "Elec. Rev.," June 24.—A reprint of a Municipal Electrical Association paper, in which he reviews briefly the various elements in the construction of electric railways. The paper is discussed editorially in the same issue, in which it is remarked that it can hardly be said to contribute anything new to the common stock of knowledge on electric traction.

AUTOMOBILE VEHICLES. Reyval. "L'Eclairage Elec.," June 18.—A short article on the recent trials in Paris, in which eleven electric and one petroleum motor took part; a more detailed description is promised, the present being only preliminary. The vehicles operated very satisfactorily; the cost per km is about 1 cent per km for the electric vehicles at the rate of 6 cents per kw hour, at which price the electric energy may be bought in Paris; the cost is about 50 to 70 cents per carriage per day, running about 36 miles; the kw hours for the trip are also given approximately, and vary in the neighborhood of 10 to 12. The cost of fuel for the petroleum carriage was considerably greater; with a consumption of 13 liters, at a cost of 12 cents, the total cost per day was $1.56. An important item in the electric vehicles is the maintenance of the battery, concerning which no information will be given in the report; the Fulmen cells behaved well, and that company will maintain the batteries at 60 cents per day per carriage, making the total cost $1.20 per day, or about double that for the energy; this is still less than that for the petroleum vehicles. The conclusions are that the electric vehicles are practical, economical and in point of comfort are much better than those operated by horses or petroleum. A short account is also given in "Eng. News," July 7.

ELECTRIC CABS IN PARIS.—Lond. "Elec. Rev.," June 24.—Brief data from the preliminary tests. It appears that the petroleum cabs have been superseded in that city by those driven electrically.

MOTOR VAN TRIALS.—Lond. "Elec. Eng.," June 24.—A brief account of the recent trials of the Royal Agricultural Society; most of the vehicles were not electrically driven.

PROPOSED CONSTRUCTION IN NEW YORK.—"St. R'y Jour.," July.—The Third Avenue Railroad Company, of New York, will install the electric conduit system on 102 miles of track, of which 28.5 miles are now equipped with cable. The change from cable to electricity is not made to secure greater economy of operation, but to give a pleasanter service and to have a uniform system over its entire line. The present cable line was laid in 1895, and the rail used was 7 inches in height, and weighed 80 pounds per yard. The joints in this time have gone down three-eighths of an inch. It is estimated that 2,500,000 cars have gone over the line during the last five years. The company will use in its new work rails weighing from 104 pounds to 112 pounds, and will increase the carbon in its rails from .45 per cent. to .55 per cent. The company will also install a large central station and distribute power by the three-phase system with eight or ten sub-stations.

BUFFALO RAILWAY COMPANY'S STORAGE BATTERY PLANT.—"St. R'y Jour.," July.—This company has recently installed a large storage battery for the purpose of regulating the fluctuating load due to the 300 or more cars in use; this is briefly described and illustrated. The station contains steam units of a capacity of 7000 horse-power, and also four 500-hp generators supplied with current from Niagara Falls. The storage battery consists of 204 cells of the chloride type, having a capacity of about 1200 horse-power; the positive terminal of the battery is connected to

the positive main bar of the switchboard, and the negative terminal with a booster to the ground; the booster has a capacity of 2500 amps. at 70 volts. A diagram shows the effect of the battery in regulating the output of the station.

SCHUYLKILL VALLEY.—"St. R'y Jour.," July.—A short description of this line, about 22.5 miles in length, near Philadelphia. The average output is about 400 horse-power when thirteen cars are in operation, but during heavy traffic eighteen cars are run, with an output of about 925 horse-power. The company uses from 5½ tons to 6 tons of coal per day, costing $1.90 per ton. Employees are paid $.125 an hour and work eleven and a half hours per day. The average life of motor gears is about eighteen months, and of pinions about eight months. The trolley wheels usually run about 48,000 km.

HULL ELECTRIC RAILWAY. Armstrong. "St. R'y Jour.," July.—An illustrated description of this line, which was formerly operated by steam locomotive power, but in 1897 was equipped with electric power. Its length is about 26 miles, and considerable freight business is done. The power station contains six turbines, connected with one shaft, from which two generators of 325 kw are driven; there are two electric locomotives; one is equipped with four 80-hp motors, the other is somewhat lighter.

GORNERGRAT RAILWAY.—"Eng. News," June 30.—Some brief data concerning this electric mountain road, which has been referred to frequently in the "Digest."

MEADVILLE.—"St. R'y Jour.," July.—A short, illustrated description of this line, which comprises about 10⅝ miles of track; the power house contains two 250-hp condensing Corliss engines, each connected to a 225-kw generator.

ELECTRIC EQUIPMENT OF THE BROOKLYN ELEVATED RAILROAD.—"St. R'y Jour.," July.—On June 18 the first electric train on the Brooklyn Elevated Railroad crossed the bridge to New York. Sections are given of the track at curves and on straight work, with the third rail in place.

LARGE STREET CAR UNITS. Brill. "St. R'y Jour.," July.—A short article in which he claims that the tendency in rolling stock is toward the largest car that can be handled by two men; this is because it is found that the cost of operation depends principally upon the number of units and not on the size of the cars.

Installations, Systems and Appliances.

UNIFORMITY IN PLANT AND APPARATUS. Wordingham. Lond. "Elec.," June 24.—A reprint of his paper, with the discussion (see "Digest," last week). The subject is also discussed in the leading editorial. While it is thought that a large variety exists in the equipment of small stations, anything more than very limited standardization is not desired in the more important stations; it is thought that the importance of standardization in large stations is greatly overrated; the chief capital expenditure is under the heading of mains; the absolute standardization of boilers is an obvious impossibility.

WAKEFIELD.—Lond. "Elec." and "Elec. Eng.," June 24.—An illustrated description of this station. This city is the sixty-ninth in which the municipal authorities control the works. The high pressure alternating system, with transformer sub-stations and distribution on the three-wire system at 200 and 400 volts, is used. It has a four-cell refuse destructor, and is now in full working order; it will supply steam at the required pressure as far as possible; 100 to 200 horse power can be developed from the refuse alone.

BOOSTER.—Lond. "Elec. Eng.," June 24.—Several explanations of the working of a direct-current booster, with diagrams of the switch gear for charging a battery from continuous-current supply mains.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," June 24.—An analysis of the accounts of the Islington station.

Electro-Physics and Magnetism.

THE ARC AS A TELEPHONE. Holsten. "Elek. Zeit.," June 23.—A short communication stating that as early as 1893 he noticed a phenomenon like that recently described by Simon (see "Digest," April 9). An arc lamp made quite a noise when run with a continuous current; the noise was produced mainly when there was sparking at the commutator, even though it was only slight; it diminished with the number of the lamps in circuit, and is also affected by the length of the arc; the noise is not always produced.

POWERFUL LABORATORY ELECTROMAGNET. Weiss. "L'Eclairage Elec.," June 18.—A detailed description of a magnet which he has constructed for giving intense fields of 30,000 units, and which is more convenient and economical than those formerly described; the weight does not exceed 220 pounds, and the energy required is less than 2 horse-power. The best results can be reached with truncated cone pole pieces, the best angle for which is discussed and is shown to be 63.5 per cent.; the force exerted between the two poles is 1320 pounds; the frame is of the rectangular type and the apparatus is conveniently mounted for introducing apparatus between the poles. The diameter of the wire is 2 mm and the current 9 amperes for ten hours or 14 amperes for ten minutes, the number of ampere turns for the latter current being 50,000; the total resistance is about 9 ohms, thus requiring about 125 volts. The fields for various currents and distances between poles are given. With 11.4 amperes and a distance of 3 mm, the force is 30,500. There are supplementary coils near the pole pieces, which he claims yield an extra thousand units; the intensity in the pole pieces is 1630 units. The proper cross section of the iron is discussed, as also the construction of an apparatus of a different scale.

EXAMINATION OF COAL BY X-RAYS. Couriot. "Eng. and Min. Jour.," July 2.—A brief abstract of a French Academy paper. He states that X-rays afford an instantaneous and certain means for determining the purity of mineral fuel; coal, diamond and wood are permeable to these rays, while silica and silicates are opaque; thus the silicious ash, forming constituents of coal, obstructs the passage of the rays; owing to the great transparency of coal, it is not necessary to trim the sample, large fragments sufficing for the test; impurities are clearly shown as dark spots. A 10-inch spark coil will answer, with an exposure of about five minutes, the samples measuring 1.25 to 2 inches. A brief account is also given in "L'Eclairage Elec.," June 18.

ELECTRICAL DISCHARGE. Moore. "Amer. Jour. of Sc.," July.—The first part of an article in which he considers some notions concerning the electrical nature of electrical discharge in gases, which are almost wholly dependent on the kinetic theory of matter; these notions are not in complete agreement with the conclusions reached by some continental and English physicists.

ZEEMAN EFFECT. Ames, Earhart and Reese. "Johns Hopkins Univ. Circular," No. 135; reprinted in "Am. Jour. of Sc.," July.—A short account of their investigation of certain variations from the phenomena discovered by Zeeman.

Electro-Chemistry and Batteries.

PLATING WITH A CADMIUM AND SILVER ALLOY.—"L'Eclairage Elec.," June 18.—It is stated that an alloy of cadmium and silver, containing from 7 to 8 per cent. of cadmium, is better for coating articles; the cadmium prevents the silver from tarnishing so easily; moreover, the alloy is electropositive as compared with nickel by 0.25 volt, so that a piece of iron covered with this alloy will be less easily attacked by oxygen and the humidity of the air than when covered with nickel. The Cowper-Coles process for thus covering articles is briefly described.

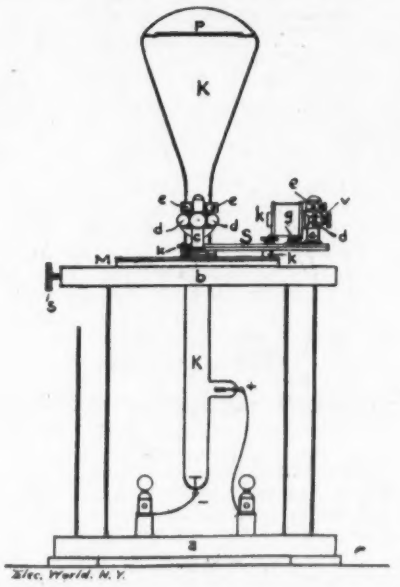
PLATING ALUMINUM.—"L'Elec.," June 25.—Various recipes patented by Lenseigne and Leblanc.

ELECTROLYTIC COPPER REFINING. Ulke. "Eng. and Min. Jour.," July 2.—An article on the progress during the past year, in which the mechanical details of this process have been improved; the article is based on what has actually been accomplished at various refineries. Not only has the quality of the product been improved, but the time required has been diminished, so that the stock of copper locked up in course of treatment is greatly reduced; copper of 100 per cent. conductivity is now an ordinary commercial product.

SIGNIFICANCE OF IONIC REACTIONS IN ELECTROCHEMISTRY. Kuester. "Am. Jour. of Sc.," July.—An abstract of his article from the "Zeit. f. Elektrochem.," August, 1897, which was noticed in the "Digest" at that time.

Units, Measurements and Instruments.

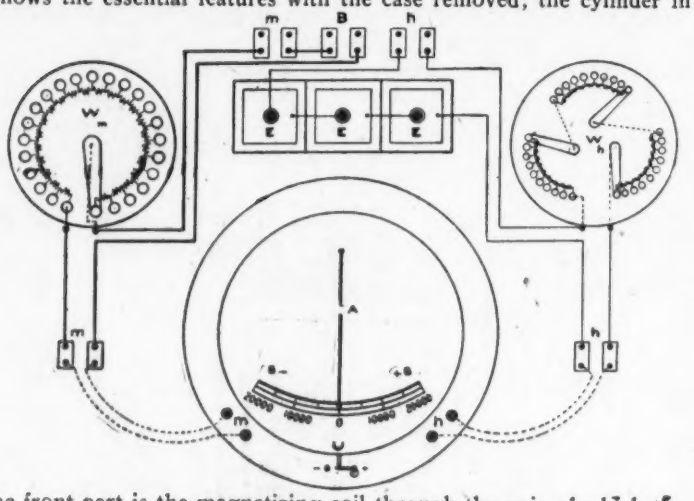
INDICATOR FOR ROTATING FIELDS AND ALTERNATING VOLTAGES. Ebert and Hoffmann. "Elek. Zeit.," June 23.—An illustrated description of an interesting and simple device for showing and studying varying fields and potentials. The fact that cathode rays are deflected by magnetic forces and by electric fields are the principles on which this apparatus is based; it will show an illuminated curve representing the rotary field, by a rotating cathode ray striking a phosphorescent plate and thus enabling every portion of the curve to be seen and studied. The apparatus



is shown in the adjoining figure, the lower part of which is the cathode ray tube, with the aluminum cathode at the bottom; at *b* there is a diaphragm which sharply defines the beam, and above this are the various deflecting apparatus; P is the screen which for

convenience has circles and diameters drawn on it for making approximate measurements. To produce the rotating field or for combining the fields of various currents, an iron ring, not shown, is placed around the tube near the table M; this ring is wound with numerous coils, which may be variously combined. With a true rotating field a perfect circle is produced, but if there are pulsations this circle will be deformed; these deformations show in how far the rotating field varies from the true one; the direction and magnitude of the deviations are also indicated; the most important feature is that by the use of small condenser plates of negligible capacity the time variation of the voltages can be followed; moreover, the apparatus can be put in any branch of an alternating current system, provided the voltage is high enough; in the present apparatus it must be at least 500 to 800, but by means of a small transformer it could be connected to even lower voltages. The magnetic field producing the deflection need be only moderate; the deflection takes place in a plane perpendicular to the direction of the lines of force; if the field rotates the beam will describe a cone; if the screen is coated with a luminous paint a bright curve will be produced, which can be photographed. In the apparatus which he used the field had an intensity of about 0.1 lines of force per sq. cm., and this was found to be ample. If two small condenser plates insulated from each other and connected to an alternating current be placed on the two sides of the tube the beam will also be deflected, and the deflections will follow the time variations of the voltage; the deflections take place in a plane perpendicular to that of the plates. If a small magnetizing coil is placed near the tube, and if between them is placed a small insulating plate perpendicular to the axis of the coil and another plate on the other side of the tube, the plates being connected to an alternating current source, the coil will produce a deflection perpendicular to its axis and the condenser a deflection in the direction of the axis; the combination will produce diagrams like the well-known Lissajous figures, from which the various forces may be determined. For a moderate frequency the induction of the coil may be neglected and the deflection of the rays is therefore practically identical with the current variations; the current and voltage curves of an alternating current system can therefore be directly compared with each other; if they are in phase a straight line will be shown on the screen, and its inclination with the axis of the coil is determined by the relation of the amplitudes; if a self-induction is connected with the circuit the shape of the line will be changed; for a difference of phase of 90° a perfect circle will be produced, provided the two amplitudes are of the same degree; for 45° difference in phase there will be an ellipse; the apparatus is therefore to a certain extent a watt indicator. The chief advantage of the apparatus is that it has practically a pointer of no mass—that is, one whose inertia is negligible—and the energy required is also insignificant. The finest pulsations and oscillations are therefore directly visible. The rest of the article consists of a detailed description of the apparatus.

APPARATUS FOR MEASURING MAGNETIC QUALITIES. Kath. "Elek. Zeit.," June 23.—A reprint of a long, illustrated paper describing in detail a simple, portable instrument made by Siemens & Halske for measuring the magnetic qualities of sample rods of iron; the apparatus is conveniently arranged, so that it may be used by those not specially familiar with such work, as, for instance, in iron foundries; it is also claimed to be very accurate. He claims that the yoke method is the best, and describes how the objections to it have been overcome in this apparatus; the results give the absolute values directly; it is an improved form of a previously described apparatus. The accompanying illustration shows the essential features with the case removed; the cylinder in



the front part is the magnetizing coil through the axis of which the sample rod is passed, the ends being clamped into the semicircular yoke piece; in the other part of this piece there is a pivoted coil like that in a d'Arsonval galvanometer, through which a constant current is passed, and the deflection of the needle will therefore indicate the strength of the field; the two small coils shown are compensating coils for correcting certain errors. The main coil is so proportioned that H in absolute units is equal to 100 times the current in amperes; the compensating coils are connected in series with the main coil, but act in the opposite direction; they are for the purpose of neutralizing the field, which the coil itself without a rod in it would have on the deflecting coil; the deflection is proportional to the number of lines of force; by using a suitable current in the deflecting coil the reading may be made to give directly for any desired cross section of the sample rod the results per sq. cm. cross section of the sample; the formula for determining this current is simply a constant given by the maker, divided by the cross section of the sample, this quotient giving the current in amperes in the movable coil. The accessory devices, consisting of switches, plugs, and resistances, are described in detail; they are so arranged that the work is greatly simplified; the resistances are so proportioned as to give 24 points of the curve; with almost no resistance and a 4-volt battery, H will equal 150, or with 8 volts 300; the field intensity is read off directly in absolute units. The apparatus must be shielded from neighboring magnetic fields or large masses of iron; the effect of the earth's field is eliminated by placing the apparatus in a certain direction marked on the case. The apparatus has been examined and tested by the Reichsanstalt, and the results are reproduced in curves. The cross section of the sample should be about one-fourth sq. cm.—that is, for round rods a diameter of about 6 mm; for sheet metal a pile of strips 5 mm in width and the same in height is used; the length of the sample is 200 to 270 mm.

UNIFORMITY IN MAGNETIZATION DIAGRAMS. Kath. "Elek. Zeit.," June 23.—A short article in which he urges uniformity in the systems of recording and showing induction and hysteresis curves; the system is the one adopted by the Siemens & Halske Company. The magnetic properties of every kind of iron are shown sufficiently well for practice by the usual induction or magnetization curve from zero up to H = 150, or for hard steel up to 300; and by a hysteresis loop between plus and minus 150, or for hard steel 300; only one-half of the hysteresis curve need be shown The scale for the induction curve should be 1 mm for every 100 C. G. S. units; the field intensity is usually represented by a scale of 2 mm for one C. G. S. unit, and for hard steel 2 mm for two units; in printing these the reduction may be one-half to one-quarter. (In another article in that same issue by the same author, abstracted above, such a sample curve is reproduced). The cross section paper should be printed in red, which will be reproduced by the usual copying processes by means of light; the lines on tracing paper or cloth will correspond well with those on thicker paper, so that the two may be superposed.

PHASE METER. Bruger. "Zeit. fuer Elek.," June 19.—A brief abstract of his recent paper read before the meeting of Union of German Elec. Engs. The apparatus is a sort of double wattmeter having one fixed and two movable coils; the two torques are opposed to each other; the deflection of one of the movable coils is proportional to the cosine of the angle; the second movable coil has a current flowing through it, which differs in phase from the current in the other movable coil by 90°, and the deflection is therefore proportional to the sine of the angle; when the angle is zero there will be only the deflection due to the cosine, while if it is 90° it will be proportional to the sine; between these two the pointer will always take a definite position.

ACCUMULATOR METER. Aron. "Zeit. fuer Elek.," June 19.—An abstract of his recent paper read at the meeting of Union of German Elec. Engs. He described one of his pendulum meters, in which the needle is moved one way by the discharge and back again by the charge; in the latter it passes the zero and has to be set at each charge; to obviate this a resistance may be used, shunting the meter so that the charging readings are about 10 per cent. lower, in which case the meter can be used when the charging and discharging is intermittent, as in the case when accumulators are connected in parallel with the dynamo. In another form of meter the charging and discharging currents are registered separately in two meters, each of which will register only in one direction.

CHANGES IN THE QUADRANT ELECTROMETER. Elster and Geitel. "Wied. Ann.," 64, p. 680; abstracted briefly with the illustration in the "Elek. Zeit.," June 23.—The principal directions of improvement are to increase the insulation in the inner part, for researches of longer duration, and to facilitate the renewal of the sulphuric acid used for damping and drying.

INTENSITY VARIOMETER. Heydweiller. "Wied. Ann.," 64, p. 735; noticed briefly in the "Elek. Zeit.," June 23.—The principle of his new instrument for measuring the earth's magnetism is that two equal declination needles are secured directly over each other with a common axis, and are perpendicular to each other, each, therefore, making with the magnetic meridian an angle of 45°; each of the four poles will then move in a nearly homogeneous magnetic field, and a change in the external force of the horizontal intensity will produce a proportionate declination.

MEASURING INCLINATION AND HORIZONTAL INTENSITY. Meyer. "Elek. Zeit.," June 23.—An abstract, with illustrations, from the Proceedings of the Natural Science Society of Freiburg, 10, No. 3. The apparatus appears to be the same as the one mentioned in the "Digest" May 28.

INSULATION INDICATOR. Kallmann. "Zeit. fuer Elek.," June 19.—A brief abstract of a paper read before the Union of German Elec. Engs. He describes an apparatus which will indicate a leakage of current between any two points of a wire. At two points of a circuit there are two equal resistances and the currents through these pass through the two coils of a differential galvanometer, which will indicate the differences between the currents going through them; when there is no loss of current there will be no de-

flection; the well-known Thompson bridge arrangement may also be used, together with an ordinary galvanometer; from the deflection the fault in the insulation can be measured. The abstract is very brief.

INTERRUPTERS.—"Jour. de Physique," June, noticed briefly in the Lond. "Elec.," June 24.—Descriptions of several new forms of interrupters for induction coils. Ducretet and Lejeune showed a mercury interrupter worked by an electric motor; it is on the Foucault principle, but the plunger moves so as not to whip up the mercury; at 300 turns per minute for radiography the motor requires 0.6 amperes at 2 volts; for fluoroscopy, 100 turns per minute are required, which consumes 1 ampere at 4 volts. Cremieu describes another type in which he eliminates the difference between the make and break currents; there is a combination of metallic contacts attached to an oscillating lever worked by an alternating current, the current in one direction consisting of a combined make and break current, and the same in the opposite direction, so that the currents are alike in quantity and shape; (the description in the abstract is not clear). Several other forms are briefly referred to.

RESISTANCE FOR LARGE CURRENTS. Derry. "L'Elec.," June 25.—Data for some resistances which he used in testing large dynamos. They were made of bands of galvanized iron wire netting; the bands were 260 mm wide, and consisted of sixteen wires, having a section of 50 sq. mm.; the length was 60 meters; the resistance at ordinary temperatures was 0.21 ohm; with 500 amperes at 240 volts the temperature was below the fusing point of lead—that is, about 300° C. Two such bands were used to absorb 400 horse-power, and three for 660 horse-power; the current density used was 10 amperes per sq. mm., but this may be increased if finer wires are used.

FLICKER PHOTOMETER. Whitman. "Science," July 1.—A short article on this apparatus. He corroborates Rood's recent statement as to the ease with which the flicker photometer is handled by observers not accustomed to its use; it is probably more easy to use by the unskilled observer than the ordinary photometers. The method used by Rood of keeping one lamp stationary and moving the other has certain advantages, one of which is that the measurements are all made at the same absolute brightness, but the arrangement is not so sensitive as that in which both lights are stationary and the photometer itself moved, and this is therefore preferable in general when the lights are sufficiently bright. It takes longer to make a setting with the flicker photometer than with others. The essence of this photometer lies in the fact that the two fields to be compared are presented to the eye alternately, in rapid succession, and not simultaneously side by side, as in other instruments; one simply notices the disappearance of a certain recurrent sensation. The time of transition from one field to the other should be as small a portion of the whole time as possible, and he therefore prefers the rotating to the oscillating apparatus He then describes a modified form which avoids some of the difficulties of the disc form; a short, truncated cone is cut through its axis and the two parts fastened together again after one-half has been reversed in direction; this is then mounted so as to rotate about the axis, which is parallel to the bar.

MEASURING SELF AND MUTUAL INDUCTANCE AND CAPACITY. Roland and Pennimann. "Johns Hopkins Univ. Circulars," June; reprinted in the "Am. Jour of Sc.," July.—In the latter journal for December last Roland published an account of a large number of new methods for measuring and comparing self-inductances, mutual inductances and capacities (see "Digest," Dec. 18). In the present article they give examples of some measurements made by some of these methods, and which show the accuracy with which a self-induction can be determined; the values determined in various ways agree among themselves within one part in 100, even though the frequency could not be kept quite constant; the results were remarkably good and showed the accuracy of the methods. The construction of standard self-inductances that will agree with each other to within one part in 10,000 is feasible by this method.

Telegraphy, Telephony and Signals.

TELEPHONIC DELIVERY OF TELEGRAMS.—"Elek. Zeit.," June 23.—Beginning with July 1 a trial is to be made in Germany in delivering telegraphic messages at the end station by means of the telephone. The present short article gives the rules and regulations governing this. The charge for such delivery, irrespective of the number of words, is 2.5 cents. In such case the telephone number instead of the address is to be given.

SPEEDS OF ATLANTIC CABLES.—Lond. "Elec. Rev.," June 24.—An editorial discussion of some recent figures. The speed obtained on the Siemens cable is, after allowing for its higher K R, 63 per cent. greater than on the Anglo-American cable.

SEEING BY WIRE. Smith. Lond. "Elec. Rev.," June 24.—A note stating that in such apparatus selenium as well as revolving mirrors will have to be superseded by something more sensitive and constant in action. He believes he can accomplish this with some ideas which he expects to be able to put into practice, but he does not disclose the principles.

TRANSMITTING PICTURES. Piedfort. "L'Elec.," June 25.—A note, with illustrations, showing a device which he described at a congress of scientific societies in 1894, and which he claims anticipates the recent suggestion of Dussaud.

WILMINGTON. Clausen. "West. Elec.," July 2.—A brief, illustrated description of the central office of the Delmarvia Telephone Company, which is claimed to be one of the most complete exchange systems of the independent companies.

INDEPENDENT MOVEMENT IN INDIANA. Beers. "West. Elec.," July 2.—A short article on the independent telephone movement in that State, in which there are now 137 exchanges, with about 20,000 subscribers and 5,000 miles of interurban lines.

Miscellaneous.

LIGHTNING.—"Elek. Zeit.," June 23.—An editorial discussion of a recent report by Kassner, giving statistics for Saxony and Anhalt for the eleven years ending 1897; the report is accompanied by a chart (which is not reproduced). The districts are indicated by the density of the buildings. It shows that in general the number of bolts of lightning which were observed is somewhat greater in the denser districts than in the more sparsely settled, but this is only approximately true; he also endeavored to find in how far the frequency of the bolts depends on the condition of the soil, and what the effect of water in the neighborhood is; in general the bolts are less frequent the greater the distance from running water, but it does not follow that there is greater danger nearer the water; in general the number of bolts increases with an increased extent of water. It may be considered as demonstrated that at least in that district the presence of forests has no apparent effect on the number of bolts. The number of bolts per square mile (presumably German miles) varies greatly in the different districts, from 1.2 to 10.4 (this apparently refers to the whole period of eleven years). Buildings on flat land are struck more frequently than those in a city; the number of bolts which produce ignition is greater on flat lands than in the cities; for 1633 "cold" bolts on the flat land there were 458 which produced ignition, which is about 28 per cent., while in the cities the numbers were 464 and 60, or 12.9 per cent. The number of observed bolts in those eleven years has increased, it being 33.7 per cent. greater in the last five than in the first five years, the increase being greater on the flat lands; formerly the bolts which did not produce ignition increased more than those which did, but this relation is now reversed; comparing the periods of five years with each other, the number of igniting bolts on the flat lands increased 45.7 per cent., and those which did not ignite 32.7 per cent.; while in the cities these proportions are 42.9 per cent. and 25.5 per cent. The maximum number of bolts on one day was 99 and on another 96; the worst month was May, 1890, when there were twenty-five days on which there was lightning; the number of bolts per day on which there was lightning varies from one in December to 5.8 in June, the mean for the whole year being 4.3; the distribution over the different hours of the day is also shown.

MUNICIPAL ELECTRICAL ASSOCIATION.—Lond. "Elec.," June 17.—A running account of the proceedings of the recent meeting. A brief running account is given in the Lond. "Elec. Rev." and in Lond. "Engineering," June 17. Lond. "Lightning," June 16, describes the various excursions of the Society and begins the publication of the papers. An account of the excursion to the shops of Willans & Robinson is published in the Lond. "Elec. Eng.," June 17.

STANDARD DIAGRAMS. Jamieson. Lond. "Elec. Rev.," June 24.—A discussion of some of the conventional diagrams which were recently proposed by the committee of the Chicago Electric Association. Side by side with a number of these he shows suggested improved forms; he has himself read a paper on this subject a number of years ago. The figures for series, shunt and compound dynamos and motors have the objection that the field is represented by zig-zag lines, which have been universally adopted to represent non-inductive resistances, which the field coils certainly are not; the diagrams are unnecessarily complicated by drawing the leads from each brush with two right lines, whereas in the usual diagrams, which he shows, the leads come straight away from the brushes. To distinguish a storage cell from a primary battery he thinks the letters S and B placed beneath the usually accepted sign is sufficient. He does not see any necessity for complicating the figure of a constantly driven magneto by representing a belt, when a mere arrow will suffice. He offers some slight improvements in the symbols for ammeters, voltmeters, etc., representing them all alike with a small letter A, V, etc., at the side. He omits the iron core in the inductive resistance, as he thinks it is unnecessary. For ground he uses the old-fashioned arrow-marked earth. The well-known symbol for non-inductive resistance is used for a transformer, and to this he objects. Several other suggestions are made. He urges the need of coming to an early state of uniformity.

ELECTRIC REGULATOR.—"L'Eclairage Elec.," June 18.—An illustrated description of the Maquaire regulator, which can be applied to various purposes, as, for instance, to the regulation of the pressure of the gas. A membrane on which this pressure acts closes one of two opposite contacts, when it moves in either direction; the contact lever is connected to a third brush on a small motor, which is placed midway between the other two brushes; when either of the contacts are closed the current circulates between that brush and one of the two others, turning the motor in either of two directions, which, by means of gearing, operates a valve or other regulating device.

ENAMELS FOR HEATING APPARATUS.—"L'Eclairage Elec.," June 18.—A brief account of the researches of Damour, in

which he endeavored to find an enamel which has a high expansion coefficient to be used for imbedding wires used in electrical heating apparatus. The principal ingredient seems to be the natural borate of calcium; various compositions are given, with their coefficients, which are very nearly equal to those of platinum, iron or nickel.

ALUMINUM FURNACE.—Lond. "Elec.," June 24.—A brief account of the researches of Goldschmidt, which were referred to in the "Digest" May 28 and June 4.

A Large Warehouse and Repair Shop.

In facilitating its relations with that large class of its customers located in the Middle and Northwestern States, and dealing directly with its Chicago sales office, the General Electric Company has found the large warehouse and repair shop which it has established in that city of the greatest value.

The warehouse and repair shop occupy a commodious and well-lighted six-story and basement building, abutting on the main lines of three railroads; also on the Belt line, which connects with all the other railroads radiating

Wire Cable and Original Packing Room.

from Chicago. From these, into a special spur by the side of the warehouse, the cars of any of the roads may be switched.

The top, or sixth floor, is devoted to the storage of unbroken packages of arc lamps, porcelain and glass insulators, insulator pins and cross arms, armatures of the older types of machines, etc. On the fifth floor is stored a stock of incandescent lamps in original packages ready for immediate shipment, fan motors, arc-lamp globes in broken lots, arc-lamp carbons, etc. At the time of writing this the incandescent lamps of various candle-powers, voltages, etc., in stock numbered roughly about 500,000, which number is kept constantly on hand by weekly shipments from the Edison Lamp Works, at Harrison, N. J.

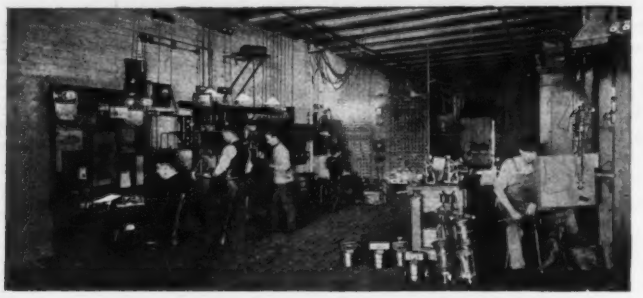
The fourth and third floors are laid out in floor bins and wall cupboards, the latter divided into pigeonholes of various sizes. Each bin and each pigeonhole bears the catalogue number of the device or part it contains. On the fourth floor are the larger wiring supplies and parts, arc lamps—single and double carbon series and open and enclosed arcs for direct or alternating circuits; car resistances, and meters and type "H" transformers of all sizes in the original factory boxes ready for re-shipment at the shortest notice. In the bins on the third floor are the smaller wiring supplies and parts: Fuses, sockets, switches, cut-outs, lightning arresters, arc-lamp parts, dynamo-motor parts, brushes, both copper and carbon, line material of all kinds, controller parts, rheostats, assembled commutators and a full stock of the new C. A. motors, as well as a heavy stock of insulated cord and wire.

The second floor contains the repair shop, fully equipped with lathes, planers, drill presses and shapers, all driven by electric motors. The front part of this room is given up to the armature rewinding department. On this floor is located also an elaborate meter lamp, and transformer testing department, as well as a dip room and polishing room for re-finishing arc lamp casings, etc. On the first floor are stored all the heavy machines—generators, motors, and the large-sized transformers. This is also the shipping and receiving room for all the stock, and one corner is devoted to the office, while in the rear is a small carpenter's shop, with planer and a circular saw driven by a 5-hp motor. An overhead track equipped with traveling chain hoists runs above this floor and out over both railroad tracks and the street and greatly facilitates the shipment or reception of the cases of supplies or apparatus. The basement contains the power plant, consisting of two 80-hp boilers and two horizontal engines, one of 100 horse-power, used for dynamo testing purposes, the other a 50-hp engine, belted to a direct-current machine, from which the lighting and power current used in the building is supplied, and to a 20-kw alternator used for meter and other testing purposes. The basement also contains a boiler feed pump, a water heater, a large fire pump, four large steam-heated ovens for baking armatures and dynamo field coils, and a switchboard divided into three sections equipped for testing high-tension series arc machines, direct-current low-tension machines and alternating testing work. Beneath the sidewalk is kept a large stock of insulating oil for transformers. The different floors are connected by a 4-ton elevator.

Bins and Cupboards.

Electric Power in New Bridge Manufacturing Shops.

The shops of the Youngstown Bridge Company, Youngstown, Ohio, which were destroyed by fire in September of last year, have been entirely rebuilt on a much larger scale. The electric power plant comprises a Buckeye engine, Style B, of 180 horse-power, which drives a six-pole compound-wound



Meter and Lamp Testing Department.

Edison dynamo of 110-kw capacity, running at a speed of 550 revolutions. The voltage of the dynamo is 250 to 275. It is arranged to furnish current to three circuits, one for power, one for arc lights and the third for incandescent lights. The switchboard is provided with one 500-ampere L-circuit breaker, Weston voltmeter and ammeter, one double-pole main switch and four double-pole feeder switches. The rheostat is mounted on the back of the board.

There are in the works twenty-five 2000-cp arc lamps, 100 16-cp 250-volt lamps and four motors, all of which are supplied with current from the one generator. One of the four motors is of 35 horse-power, running at 600 r. p. m. at a pressure of 250 volts. This motor operates a group of eight machines, consisting of punches, angle shear, plate shear and Sturtevant blower. A second 35-hp motor operates another group of machines, seven in all, including drill presses, rotary planers, bending rolls and rivet header. A 10-hp slow-speed motor, running at 850 r. p. m., operates a straightening machine, cold saw, radial drills and a large emery grinder. The fourth motor, which is also a slow-speed motor of 5-hp, runs at 1000 r. p. m. This motor drives a circular saw and a wood-boring machine.

In addition to this equipment the company also has ten 1-hp electric hoists. When all the machines are in operation, and all the lights in use, the greatest amount of current used is 125 amperes.

The steam generating plant includes two 100-hp and one 75-hp boilers, which supply steam, not only to the main engine, but also to a steam hammer, several air compressors and a steam riveter. The several motors referred to above are distributed throughout the main shop, while the machine shop is directly operated by engine-power. The construction of the main building, an interior view of which is given herewith, as well as all the other buildings, is of the most approved type throughout. The main trusses are 20 feet apart, and are arranged to carry trolleys on the bottom chords of from 7½ tons to 10 tons capacity. Material is unloaded directly from cars into the shop.

The company builds bridges for the leading steam and electric railways and cities, steel buildings for car barns, electric power stations, etc., and general structural work.

Electric Power in Bridge Manufacturing Shop.

NEWS OF THE WEEK

Financial Intelligence.

BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has increased its capital stock from $75,000 to $100,000.

GENERAL ELECTRIC COMPANY'S AFFAIRS.—It is stated that at a meeting in Boston of the General Electric Preferred Stock Committee the proposal of the directors to reduce the stocks of the company, both preferred and common, 40 per cent., to $60 par value, was considered. A majority of the committee decided not to recommend this proposition to the preferred stockholders.

Special Correspondence.

NEW YORK NOTE.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, July 11, 1898.

THE A. I. E. E.—At the meeting of the Executive Committee of the American Institute of Electrical Engineers, June 24, Mr. C. O. Mailloux, of New York, was elected a vice-president of the Institute to fill the vacancy caused by the election of Dr. A. E. Kennelly to the presidency. Mr. Robert N. Baylis was also appointed a member of the Board of Examiners, succeeding the late Dr. Charles E. Emery. The following associate members were elected: Walter Cummings Allen, inspector of electric lighting, Government of District of Columbia, Washington, D. C.; Albert H. Armstrong, electrical engineer, General Electric Company, Schenectady, N. Y.; George A. Damon, with B. J. Arnold, electrical engineer, Chicago, Ill.; Frank H. Dexter, student Cornell University, Ithaca, N. Y.; P. M. Downing, superintendent electrical department Blue Lakes Water Company, Blue Lakes City, Cal.; Joseph Lyons, patent solicitor, with Gustav Bissing, Washington, D. C.; Alfred A. Thresher, electrical engineer and proprietor Thresher Electric Company, Dayton, Ohio; William B. Jackson, New York and Staten Island Electric Company, West New Brighton, N. Y.; Paul M. Lincoln, electrical superintendent Cataract Construction Company, Niagara Falls, N. Y.; Thoburn Reid, consulting electrical engineer, New York City; Philip Green Gossler, electrical engineer, Royal Electric Company, Montreal, P. Q.; Theodore E. Theberath, Pacific Coast engineer, Stanley Electric Company, San Francisco, Cal.; Frederick M. Pedersen, assistant electrical engineer, Crocker-Wheeler Electric Company, New York City; Will K. Dunlap, electrical engineer, Westinghouse E. & M. Company, Niagara Falls, N. Y.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 9, 1898.

MR. CHARLES E. NEWTON, secretary of the Jewell Belting Company, Hartford, Conn., has our sympathy, also the sympathy of the entire electrical field, over his recent bereavement through the death of his estimable wife, Mrs. Alice Huntington Newton. Mrs. Newton was the daughter of Prof. Charles W. Huntington.

MESSRS. WILLIAM J. MURDOCK & CO., Boston, report a good demand and sale for the "M" telephone receiver, which is the pony type, high grade, bi-polar, with hard rubber case, plate-binding posts, double-pole magnet of the best magnet steel, weighs 12 ounces and will operate any standard switch. The magnet is supported near the diaphragm, so that the change in temperature does not affect adjustment.

THE BIBBER-WHITE COMPANY, Boston, has recently acquired by purchase all rights, title and interest in the stock, tools, factory and good will of the American Electric Company, Boston, manufacturer of burners and fittings. The Bibber-White Company will continue to produce such goods as were manufactured by the American Electric Company, including the "New Era" and "Victor" burners, keeping a large stock constantly on hand from which shipment can be made.

THE BOARDMAN-TUCKER COMPANY, Boston, Mass., manufacturers of telephones and specialties, reports a very nice business. Its common battery system is attracting favorable recognition from the trade, as is also its transmitters and new receiver, which possesses important features, and is sold separately or in connection with its combination sets. Mr. Boardman, electrician of this company, is well and favorably known to the telephone industry, and Mr. F. S. Tucker, his associate, is possessed of admirable practical knowledge and experience regarding the manufacture of telephones.

MR. T. W. NESS, of the Holtzer-Cabot Electric Company, Boston, has just returned from an extended Western trip, during which he visited telephone exchanges. He reports the outlook as very encouraging for the independent telephone business, old and cheap apparatus being rapidly discarded for better and more efficient, and as the Holtzer-Cabot apparatus is prominent in the latter classification, particularly the new automatic switch and intercommunicating system, Mr. Ness was able to book quite a number of good orders. His trip was successful beyond even sanguine expectations.

MR. F. A. SWAN, well known in electrical circles in Boston, has recently purchased the business of the old Boston electrical establishment of Charles L. Bly, 37 Pearl Street, in business since 1864, and in which Mr. Swan served his apprenticeship some twenty years ago. Mr. Swan will continue the business at the old address, largely increasing the facilities. It is quite safe to say that the excellent business which this old firm has always commanded will not only be held by Mr. Swan, but that it will be materially enlarged because of his wide acquaintance and intimate knowledge of electrical construction and the manufacture of electrical specialties.

TRAVELERS on the New York, New Haven & Hartford Railroad, as they pass through Jamaica Plain, near Boston, Mass., now look out on the large manufacturing establishment of the B. F. Sturtevant Company, and wonder at the disappearance of the tall boiler chimney, which previously stood as an evidence of so much invested capital. It had, however, outlived its usefulness, and its value was measured only by the possible utilization of its bricks, for a substitute had been installed in the shape of a Stutevant fan for providing the draft. The invisible products of combustion are now discharged through a small stack extending such a short distance above the boiler house roof as to be hardly noticeable. Thus does the new and efficient method push out that which is old and wasteful. No longer is a manufacturing plant to be identified by the existence of a tall chimney, for the time is at hand when the progressive engineer will seek for a more convenient and efficient substitute. The boiler plant is of about 300 horse-power, and is effectually served by a fan having a wheel 54 inches in diameter, driven by a direct connected upright engine whose speed is so regulated that it increases as the steam pressure falls, and thus maintains practically constant steam pressure. A mixture of half and half Cumberland coal and yard screenings is used with absolute smokelessness, and in a recent test the Orsat apparatus gave no evidence of the presence of any carbonic oxide in the gases. An efficiency of 11.05 pounds of water evaporated into dry steam per pound of combustible was shown at a combustion rate of 16.45 pounds per square foot of grate. With the plant of sufficient size to warrant the introduction of an economizer, the otherwise wasted heat of the gases (although their temperature is only about 450 degrees) could be readily utilized.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., July 9, 1898.

THE STANDARD CONDUIT manufactured by the Standard Fireproofing Company, Perth Amboy, N. J., is reported to be meeting with great favor in Philadelphia, and is rapidly coming to the front. The company reports that it will lay about 200,000 feet of its conduit within the next few months. The company's exhibit at the Philadelphia Exhibition attracted the attention of those interested in that particular line, and Mr. M. J. Harrington, who had charge of the exhibit, did some good missionary work on behalf of his company.

MOORE VACUUM TUBE LIGHTING AT THE EXHIBITION.—One of the most popular features at the Electrical Exhibition at Philadelphia was the vacuum tube exhibit of Mr. D. McFarlan Moore. This system of illumination was very attractively exemplified in the lighting of a Turkish smoking room luxuriously furnished in true Oriental style. On the walls of the apartment near the ceiling were curved glass tubes about 2 inches in diameter, set off with highly polished brass fixtures. From each corner to the centre of the vault there is an arch span of glass, which, with those along the walls, gave out the characteristic light of vacuum tubes. The room was wired on the Moore three-wire system; that is, the tubes were connected in parallel between two wires. These wires entered the top of a small polished oak cabinet, which contained all the apparatus necessary to operate the tubes. The power was taken from the street railway mains of the Edison Company, and high tension was obtained by induction coils in the "rotator vacuum brake," which has already been described in the columns of THE ELECTRICAL WORLD.

THE FRANKLIN ELECTRIC SUPPLY HOUSE has been established by Mr. H. P. Feister at 506-508 North Street, near Fifth and Arch Streets. Mr. Feister was owner and proprietor of the Franklin Machine Works, Philadelphia, which he successfully carried on for many years. As a business man, financier and manager he is successful, and his abilities in these directions bespeak for the new enterprise success from the start. He has secured agencies for the following named concerns: The Commercial Electric Company, dynamos and motors; the Highland Electro-Chemical Manufacturing Company, Highland soldering paste; the W. S. Hill Electric Company, switches and switchboards; the Ohio Electric Specialty Manufacturing Company, automatic motor starters, commutator lubricant, Perfection brushes, woven-wire brushes and leaf copper brushes; McNamara Brothers, slate and marble for all purposes; Riley Brothers, magic lanterns, stereopticons, kineoptoscopes; Schmidt & Bruckner, "Twentieth Century" telephones; Prismatic Electric Sign Company, "Prismatic" electric signs; Oshkosh Logging Tool Company, electric construction tools; John Rauscher, push buttons; the Franklin incandescent lamp; American burners; Crefeld wire and cables.

WASHINGTON NOTES.

WASHINGTON, D. C., July 9, 1898.

A DEED OF TRUST upon the plant and stock of the Potomac Electric Power Company for $750,000 has been filed. The capital stock of the company will be increased from $500,000 to $1,000,000.

TELEPHONE RATES.—A bill making appropriations for the District of Columbia for the fiscal year 1898-99 contains the following clause: "That from and after the passage of this act it shall be unlawful for any person or any telephone company doing business in the District of Columbia to charge or receive more than $50 per annum for the use of a telephone on a separate wire; $40 for each telephone, there being not more than two on a wire; $30 for each telephone, there being not more than three on a wire, and $25 for each telephone, there being four or more on the same wire." It is stated that the enactment of this privision was brought about after an active campaign by the local

telephone users and consideration of the subject by both Houses of Congress. It is highly probable that the Chesapeake & Potomac Telephone Company will use all the means at its command to thwart the efforts of those who desire to see the law upheld, but there sems to be a very general and decided inclination among users of telephones to compel it to obey. This sentiment, it is thought, will undoubtedly lead to organized action by telephone users. The plan now being considered includes a purpose on their part to decline to pay a larger sum for telephones than the law permits, taking the ground that by so doing they will violate the law. In case the company should attempt to remove the instruments from the premises of those refusing to pay more than the legal tariff, the latter will secure injunctions from the courts and thus the question would be brought up for final settlement.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., July 9, 1898.

THE NIAGARA GORGE RAILWAY, a trolley system, is now a part of the through line from Lake Erie to Lake Ontario, an arrangement having been made with the New York Central Railroad.

THE BUFFALO POLICE DEPARTMENT has learned that for three times the annual rental of the Bell telephone plant it can buy a system of its own, and steps have been taken to put the discovery into practice. Contracts for 155 receivers have been awarded to the Wilhelm Telephone Company, of Buffalo, on its bid of $2.25 each, and for as many receivers to the Pennsylvania Electric Company, on its bid of $3.77 each. Several bids are in for cables, but no awards have been made.

THE FIGHT between North Tonawanda and the Ely Trolley Company over the location of the tracks of the company's new line from Buffalo to Lockport is over, the town appearing to come out best, as a 3-cent rate, with transfer privileges, was secured to laboring men in the corporation, and a 25-cent rate to Buffalo and return, all day, to anyone. In return the city granted Mr. Ely all the privileges now enjoyed by his Niagara Falls line. The next fight is likely to be with the steam roads for a right to cross their lines at North Buffalo.

THE CATARACT POWER & CONDUIT COMPANY is about to establish a new distributing station near the city line where the power cable comes in from Niagara Falls, and bought a piece of land for the purpose. It is not on the present line, but the line of conduits that are now being laid will pass through the building, which is to be the point of union of the two methods of transmitting the current. It seems not to be settled whether to put any transformers in the station at present or not, but this will not be done probably till there is a demand for power in that vicinity.

Pittsburg Note.

Pittsburg, Pa., July 8, 1898.

TROLLEY CAR EXPRESS SERVICE.—The Consolidated Traction Company has had introduced into councils an ordinance giving it the privilege of running express cars on three of its lines. If the ordinance is passed the company proposes to establish a regular express service between the city and East Liberty. The success of the mail cars now in operation indicates, according to President C. L. Magee, that it is feasible to operate express cars, and the introduction of them will materially reduce the number of delivery wagons on the streets. It is proposed to establish distributing stations at intervals along the lines, where light wagons can call for and leave packages, thus avoiding the necessity of long hauls by horse-power.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., July 9, 1898.

MR. W. D. SARGENT, president of the International Brake Shoe Company, Chicago, sailed for Europe last week to make arrangements for the manufacture of the Diamond "S" shoe in several European countries, including Russia. The success of this shoe since its introduction last fall has been little short of phenomenal, and it is doubtful if any railway device of recent invention has been so thoroughly and consistently pushed on all occasions as this brake shoe has been.

A CONFERENCE was held a few days ago between the superintendents of the Chicago Edison Company, the Chicago Telephone Company, the Postal Telegraph Company and the Western Union Telegraph Company and Commissioner McGann to consider the subject of man-hole explosions. Means for preventing the increasing recurrence of these accidents was considered, and the companies agreed to put in new and improved ventilating apparatus. It is expected that fewer accidents of the kind will result from the installation of the improved devices.

Milwaukee Notes.

Milwaukee, Wis., July 8, 1898.

JUDGE SEAMAN, in the United States Court, on July 5 handed down his opinion in the suit of the Western Electric Company against the American Rheostat Company and others of Milwaukee in favor of the petitioner. The effect is to prevent the defendant company from further manufacturing of certain types of rheostats and cut-outs, the court claiming that the defendant has been infringing the patent of the complainant.

MAYOR ROSE purposes to fight for the 4-cent fare even if the city did lose the case. While the right of the city to pass another ordinance is conceded, it is claimed on behalf of the Milwaukee Electric Railway & Light Company that the city's position is not nearly so favorable as it was when the first ordinance was passed. At the present time the company has the decided advantage of the decision of United States Judge Seaman, declaring a 4-cent fare confiscatory and decreeing the value of the property of the company upon which it is entitled to compensation to be at least $7,000,000. While it is claimed by the city that the conditions are vastly different now, that the company stands in a better position to grant a 4-cent fare than it did in 1896, this contention is denied. The company is not in the least alarmed at what the city proposes to do.

St. Louis Notes.

St. Louis, Mo., July 8, 1898.

MUNICIPAL WIRES TO BE BURIED.—The Council has decided that the city's wires should go underground. A motion that the Council appropriate the $53,000 necessary was made. The amounts allowed the various departments will be cut in order to find the money.

THE PRESIDENT of the Terminal Railroad Company says that after a thorough search he has failed to find any practical plan by which the steam engine now used in the tunnel and railroad yards can be satisfactorily substituted by electric motors. The large number of trains hauled by the company on the St. Louis and East St. Louis yards and through the tunnel could not be properly cared for with the electric engines now obtainable, he says.

THE PROMOTERS of the electric railway which is to connect St. Louis, Alton, Collinsville, Edwardsville, Venice, East St. Louis and other towns in Madison County, met at Edwardsville this week and elected the following officers: Charles E. Carroll, president; John A. Mehling, vice-president, and August Holthaus, secretary and treasurer. Application has been made for incorporation papers, and as soon as they are received the work of securing franchises will be begun.

THE STRIKE OF ELECTRICAL WORKERS.—A conference was held last week between members of the Electrical Exchange and the secretary of the Building Trades Council, who represented the Electrical Workers' Union, and an agreement between the electricians and their employees was reached. The members of the Exchange agreed to pay the wage scale asked for by the union, which is $3 per day, for a period of three years. It was also stipulated that the men can only work for the firms which are members of the exchange, and in case they work for outside parties they lose their standing in the Building Trades Council. It was also agreed that all firms not members of the exchange should join at once.

Colorado Notes.

Denver, Colo., July 7, 1898.

LARGE LIGHT AND POWER PLANT.—The Rocky Mountain Power Company has just been incorporated to build a large light and power plant in Lafayette, Col. It is the purpose of the company to furnish current to the coal and metalliferous mines that are located at and near Lafayette.

GOLDFIELD POWER PLANT.—It is announced that the large electric power plant at Goldfield, Col., will be completed in three months. The plant is being built by the Smith-Moffat syndicate, of Denver, and it will supply power to supplant steam in mines in the Cripple Creek district. One of the local papers says that "another year will find a large percentage of the mines in the Cripple Creek district operated by electric power. Steam will be to a large extent superseded as a motive power for hoisting and air-compressing, and will be used only for pumping."

INSURANCE CASE.—The Denver Consolidated Electric Company was victorious in the suit brought against it by a score of insurance companies. The suit grew out of the destruction by fire of the Denver Union depot in 1894. After the insurance companies had paid over $60,000 in fire losses they came to the conclusion that the fire was due to the crossed wires of the electric light company, and action was brought to recover the amount paid out as fire loss. When the case came on for trial in the district court Judge Johnson granted a non-suit on the ground that no negligence or responsibility had been proved against the electric company.

RECEIVERSHIP FOR CABLE COMPANY.—Edward C. Baggs has been appointed receiver for the Denver City Railroad Company, which operates the cable system of Denver. The appointment of a receiver was made upon application of the bondholders of the road, who have failed to receive their interest. The failure of the company is due to the fact that the cable system is so expensive a means of operation. The company has long realized the truth of this assertion, and, as has been noted in this correspondence, has made application to the city government for the privilege of introducing the trolley system. It is thought not unlikely that if the application had been promptly granted the receivership might have been averted. The ordinance giving the company a franchise to change its motive power has been adopted by the Board of Aldermen, but it hung up in the Board of Supervisors. Opposition has been made to the grant on the ground that the company does not offer to pay a high enough price. It agrees to pay $2500 per annum for twenty years, but a certain class of persons makes a demand that it pay a percentage on its gross receipts, which would amount to a sum considerably in excess of what the company is willing or probably would be able to pay. It is believed that when a scheme for the reorganization of the company is agreed upon it will proceed on the theory that the trolley system shall be introduced. The company has been in financial difficulties since 1894, when G. E. Randolph was appointed receiver. He held the position for three years until a reorganization was effected. At that time $4,000,000 in bonds were issued, and no interest has been paid.

Pacific Coast Notes.

San Francisco, Cal., July 3, 1898.

THE ELECTRIC LIGHTING PLANT in Dayton, Ore., may be purchased by the town authorities and operated as a municipal plant.

THE MARKET STREET RAILWAY COMPANY, San Francisco, recently declared dividend No. 11, of 60 cents a share, on its issued capital stock, for the quarter ending June 30.

THE SAN FRANCISCO ELECTRICAL COMPANY, H. P. Thayer, man-

ager, now occupies new salesrooms at 31 Second Street, with a large stock of telephone and other electric supplies.

THE NEW FORTIFICATIONS at Magnolia Bluffs, near Seattle, Wash., will be well lighted by electricity, the War Department having increased the appropriation to $84,000. The contracts for lighting and heating have been let.

THE COMMERCIAL LIGHT & POWER COMPANY, San Francisco, is erecting a brick central power station on Battery Street, near Pacific. A Stanley two-phase electric equipment will be operated by McIntosh & Seymour compound engines.

THE CALIFORNIA AUTOMATIC TELEPHONE COMPANY, San Francisco, recently gave a press reception, which was attended by many representatives of the daily and technical press. The working of the improved switchboard was thoroughly demonstrated.

THE STANDARD ELECTRIC COMPANY, of California, recently made application for a franchise for the erection of a transmission line from Lake Chabot, via Haywards, into Oakland, Cal. This application is for the last section of the projected line from Blue Lakes, in Amador County, to San Francisco Bay. Franchises and rights of way through private lands have already been secured through Amador, Calaveras, San Joaquin and Contra Costra Counties by L. C. Bullock, who is associated with Prince Andre Poniatowski in the project of transmitting power 110 miles to San Francisco.

MR. WYNN MEREDITH, who has been acting as construction engineer for Hasson & Hunt, consulting electrical engineers, for several years past, has gone to Unalaska, where he will do electric work for the Alaska Commercial Company. A number of steamboats has been built in the vicinity of Unalaska, which are to be equipped with electric lighting plants. Mr. Meredith was a constructing engineer at the World's Fair and assistant electrical engineer at the California Mid-Winter Fair. He has done important work at the Folsom plant, Nevada County plant, Los Angeles street railway plant and, lately, on the new water-power electric plant, near Victoria, B. C.

CANADIAN NOTES.

MONTREAL, Que., July 6, 1898.

THE RATEPAYERS of Thorold, Ont., will be asked to sanction a loan of $7000 to extend the electric light plant.

AN ELECTRIC LIGHT PLANT will likely be installed to furnish public and private lighting at Maniwaki, Que.

THE LOCAL electric company at Wallaceburg, Ont., has agreed to install an incandescent plant within eight months.

THE TELEGRAPH and electric light companies at Lindsay, Ont., will probably be asked to lay their wires underground.

A JOINT STOCK COMPANY is being formed for the purpose of constructing electric light and waterworks systems at Shawville, Ont.

THE CITY COUNCIL of Brantford, Ont., has decided to dispense with gas for lighting purposes, and will call for tenders for electric light; also for installing an electric light plant, to be controlled by the city.

ORILLIA, ONT.—Tenders are invited by the town for a street lighting plant, an incandescent lighting plant, power service and steam plant. Particulars can be obtained from the town clerk or R. J. Clarke, consulting engineer, Toronto.

DR. SHAW, Lucan, Ont., is making arrangements to construct telephone lines to some of the neighboring villages. We understand a line is to be built first to Southgate, in London township, and after to Saintbury and Mooresville.

THE RAILWAY COMMITTEE of the Privy Council at Ottawa considered the bills for electric railways in the neighborhood of Montreal. The North Shore Electric Railway was granted a charter. This company proposes to build a road from Three Rivers along the northern shore of the St. Lawrence. The Montreal & Southern Counties Railway Company was given power to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville. The promoter of both of these undertakings is Mr. A. J. Corriveau.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 23, 1898.

ELECTRIC LIGHT IN ALGERIA.—The Municipal Council of Oran is considering the proposition made by the gas company to supply electric light to private consumers at a maximum price of 15 centimes (3 cents) per 100 watts, with a reduction of 20 per cent. in the price to the town. The company asks for a franchise to enable it to string wires in the territory of the municipality, and the lease of a strip of land for eighty years, on which to erect a power station.

THE PAYEN ACCUMULATOR.—This system of accumulator plate, the invention of M. Clement Payen, consists of porous crystallized lead, arranged so as to give great strength without sacrificing simplicity of construction. The small porous crystalline lead plug constitutes the active material, and is supported in a square of conducting material arranged so as to assure at all times good contact between the plug and the grid and at the same time allow for the expansion of the lead. The whole arrangement makes it possible to secure good contact and to keep the plates from changing shape or buckling.

ELECTRIC CARRIAGES.—On June 15 the exhibition of electric carriages opened at the Tuileries Gardens. Among them are the many different forms of hacks and cabs which the companies will try to introduce for carriage service in Paris. Some of the more remarkable ones are the following: A coupé, built by Doré; a coupé and a victoria, by Krieger; a coupé and a victoria of the General Electric Carriage Company, and also one of the French Automobile Carriage Company. They have already been put through a preliminary trial over a measured course, and have been subjected to various tests on the expenditure of power required on a level, on a hill, at starting and at various speeds, etc. It is intended also to determine for each carriage the cost of operation per day, the reliability in service and the relative comfort of passengers. The jury has twelve members, six of whom are appointed by the commission for the cabs exhibition and the other six by the exhibitors. At present the compiling of the results has not been entirely completed.

THE MICROPHONE IN WAR TIME.—A new microphone has been exhibited before the Academy of Sciences. It detects at a great distance the approach of a ship, whether an armored vessel or a torpedo boat, and gives its warning with great clearness. It is to be subjected to tests at Cherbourg. Some years ago Commander Banare proposed an instrument which he called a hydrophone, and with which he was able to hear at a distance of a mile or a mile and a half the vibration produced by the screw of a torpedo boat, or the more regular beat of the screw of a large battle ship. It consisted of a water-tight box, the vibratory plate being inside to prevent the pressure of the water from acting on it too directly. The wires from the transmitter were carried first to a float to make sure that the transmitter would be continuously immersed; from the float the wires were carried to a receiver on a ship or on shore. Thus with 2 or 3 miles of wire it becomes possible to receive a warning of the approach of a vessel from 4 to 5 miles distant.

General News.

THE TELEGRAPH AND TELEPHONE.

CURRIE, MINN.—Currie has been connected by telephone with Tracy, Canby, Balaton, Walnut Grove, and the line is to be extended to Avoca, Fulda, St. Paul and Minneapolis.

PORTERVILLE, CAL.—The Mt. Whitney Telephone & Power Company has been sold to J. H. McFarland. It is said to be Mr. McFarland's intention to put the plant in thorough working order.

EVANSVILLE, IND.—A telephone company composed of Evansville capitalists has been organized. The company proposes to construct a line into the counties west of here to connect with the city.

BOONE, IA.—The Boone County Telephone Company has placed an order with the Sterling Electric Company, of Chicago, for a toll board, which, it is stated, will be the finest of its size in the State.

BELLAIRE, OHIO.—Mr. G. M. Daniels has been awarded the contract to build a telephone line from Bellaire to Barnesville, Ohio, a distance of 24 miles. He expects to begin the work of construction at once.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company has decided to increase its capital stock $1,000,000. It is understood that the toll line system will be extended to the principal points in Minnesota and the Dakotas.

BOSTON, MASS.—It is stated that the local telephone companies, operating under the American Bell patents, will spend in extensions during the year 1898 $12,000,000, increasing the wire mileage at least 150,000 miles and their subscribers 60,000.

ST. JOHN, MICH.—The National Telephone Company has completed its long-distance line to Owosso, connecting at that point with 200 subscribers of the Owosso Telephone Company, also connecting with the long-distance lines of the new State Telephone Company.

BOSTON, MASS.—Mr. Charles Webster, vice-president and general manager of the Western Electric Telephone Company, who was in Boston a few days ago, gave out some interesting facts regarding the independent telephone movement in the West. According to a Boston financial paper, Mr. Webster states that his company's system is composed of 3000 miles of toll lines in operation in Minnesota, Iowa and North and South Dakota. Copper metallic circuits have been built on all the trunk lines, and his company is now erecting a line from St. Paul to Duluth, Sioux Falls, Lacrosse and other places, 1000 miles in length. By January 1, 1899, the company expects to have 5000 miles of wire in operation. The system is composed of the Union Electric Telephone Company, with a capital of $100,000; the Minnesota Central Telephone Company, capital $100,000; the Western Electric Telephone Company, $100,000; the Western Minnesota Telephone Company, $30,000, and the Southern Minnesota Telephone Company, $30,000. After a year's fight the independent companies have obtained franchises in St. Paul and Minneapolis. In Minneapolis, the Minnesota Mutual Telephone & Telegraph Company has been organized with a capital of $300,000, and the company, Mr. Webster states, has already between 5000 and 6000 subscribers on five-year contracts on the basis of $48 per year for long-distance instruments. The new company will not start for a year at least. It is now putting its wires underground. His company, Mr. Webster states, has the largest independent system in the country, although the oldest of the six companies is but three years old. The Northwestern Telephone Exchange Company, which operates in St. Paul and Minneapolis, has recently increased its capital stock $1,000,000 for the purpose of extending its lines.

ELECTRIC LIGHT AND POWER.

BUNKER HILL, ILL.—An electric light plant to be owned by the city will be established at a cost not to exceed $10,000. For $6900 of this amount 5 per cent. fifteen-year bonds will be issued.

LOS ANGELES, CAL.—The Southern California Power Company has let contracts for new electrical machinery to cost $100,000. This new apparatus will be installed at the power house in the Santa Ana Canyon and the distributing points at Los Angeles and Pasadena, at which places the power is to be used.

LANCASTER, PA.—Messrs. F. E. Bailey & Co., representing the Manheim Electric Light Company, have received a contract for lighting the borough of Mt. Joy with electric lights. It has not yet been decided whether to erect a plant in Mt. Joy or to obtain current from the Manheim plant, which is some miles distant.

FAIRMOUNT, W. VA.—The Fairmount Electric Light & Power Company has just secured a five-year contract with the town for 35 2000-cp street arcs at $84 per year, and 30 32-cp incandescents at $15. The company will immediately increase its incandescent plant by about 150 kilowatts in new machines, and 200 horsepower in engines. Mr. Smith Hood is manager and E. S. Aldrich is electrician.

JAMAICA, L. I., N. Y.—The Queens Borough Electric Light & Power Company, recently incorporated, has absorbed the Citizens' Lighting Company, of Far Rockaway. The Queens Borough Company has executed a mortgage to the Colonial Trust Company, of Manhattan, and has issued bonds for $250,000 at 5 per cent., maturing in 1928. The principal stockholders of the new organization are: R. C. Peabody, Van Wyck Rossiter, Joseph C. Biglin, Frank MacGovern, Isaac M. Sutton and T. S. Williams.

Obituary Note.

DR. CORNELIUS HERZ, who in late years became notorious through his connection with the Panama Canal scandal, died at London, England, on July 6. Dr. Herz was some years ago interested to a large extent in various electrical enterprises in this country and in France. He was born in Besançon, France, in September, 1849, and was three years old when his family settled in America. He was given a university education, and obtained a physician's degree. He joined the French army during the Franco-Prussian war, and at the end of the war returned to the United States. In San Francisco he established an important electric works, and did much toward developing electrical industries on the Pacific coast. Some years after that he returned to Paris, where he founded the paper "La Lumière Electrique," and was among the first to develop the electric light in that city. He became deeply interested in projects for electric railways, and conducted experiments on cables and telegraph lines in France for many months, perfecting his theories, afterward put into practice. Since the Panama Canal scandal in Paris, Dr. Herz has been practically banished from France, residing in England. He was quite wealthy, having made considerable money in promoting electrical enterprises about the time of the first Paris Exposition in 1881. It is thought by some that he was not technically strong, his chief abilities being as a business man and promoter. His property in France was confiscated, and as an American citizen he filed a claim for $5,000,000 against the French Government in the State Department at Washington, which has recently been under advisement.

Dr. Cornelius Herz.

Personal Notes.

CAPT. WILLARD L. CANDEE, managing director of the Okonite Company, sailed for Europe on the Cunard line steamer "Etruria" on July 9.

MR. MAX LOWENTHAL has been added to the staff of "The Electrical Engineer" in the capacity of associate editor. Mr. Lowenthal's training especially qualifies him to occupy a position of this character.

MR. GEORGE C. EWING, of the firm of Huntress & Ewing, Boston, Mass., manufacturers of the National electric headlight, is sergeant in Company F of the First Regiment of Volunteer Engineers, U. S. A. Mr. Ewing's regiment is now at Camp Townsend, Peekskill, N. Y., awaiting orders.

MR. E. DYSTERUD, superintendente de la Compania de Luz Electrica y Fuerza Motriz, Monterey, Mexico, is in the United States visiting important electrical plants and manufacturing establishments. The company is extending its business, particularly in the way of power transmission.

MR. JAMES MITCHELL, of Rio de Janeiro, Brazil, was in New York during the past week. It is Mr. Mitchell's intention to spend the summer in the Adirondacks, returning to his home in South America during the fall. Mr. Mitchell deals exclusively in electrical machinery of American manufacture, and during his seven years' business in Brazil has built up a large and lucrative trade.

MR. WILLIAM S. BRAYTON, of the New York office of the General Electric Company, was married May 3 to Miss Alice Wait, of Ithaca. Mr. Brayton is a graduate of Cornell, and passed through the works at Schenectady before assuming his duties at the New York office. He is a favorite among all his associates, who testified their appreciation by presenting him with a handsome souvenir of their esteem. We offer our congratulations to the happy couple on entering their new career.

Legal Notes.

APPLIED FOR A RECEIVER.—According to a Chicago press dispatch application was made in that city on July 1 by M. B. Kennedy for the appointment of a receiver for the Western Telephone Construction Company. The company was organized on March 3, 1898.

SUSPENDED SWITCH CASE.—The United States Circuit Court has granted a decree in the case of the Thomson-Houston Electric Company v. George Buehler, Frank H. Platt and the Columbia Machine Works, enjoining them from manufacturing switches for overhead trolley lines covered by the Van Depoele patent No. 424,695. It was further ordered and decreed that the following claims of said patent are good and valid: "3. The combination, with an overhead wire for receiving an underneath contact, of a switchplate attached to the wire in about the same horizontal plane as the wire." "4. The combination of a track having switches, an overhead conductor above the track and having switches, and a car on the track provided with a contact carrying arm arranged to engage the conductor at a point in rear of the front wheels of the car." "11. The combination, with an overhead line wire, of a grooved contact device pressed against the wire and receiving the wire between the flanges of the groove, and a guiding switch plate connected to the wire, against which the said flanges bear in passing from one line to another." "19. In an electric railway, the combination, with branching overhead conductors, of an upwardly pressed contact arm, carrying a grooved wheel embracing the conductor, and a switch plate at the branching point adapted to receive the tips of the wheel flanges, and provided with depending ribs, between which the wheel is free to move laterally to engage with one of the branch conductors. 20. In an electric railway, the combination, with an overhead switch plate having depending ribs, but open at its extremities, of main and branch conductors extending from its two extremities, respectively, a vehicle, an upwardly pressed contact arm attached to the vehicle and tending to move laterally therewith, and a track switch for the vehicle located so as to operate in advance of the conductor switch." "23. The combination, with branching overhead conductors, of a vehicle having a laterally swinging contact arm pressed upward to engage the conductors, and a switch plate at the branching point having depending sides, but open at its extremities, the interior width of the plate between the sides being greater than the thickness of the contact wheel, whereby the wheel is free to move laterally with relation to the main conductor and engage one of the branching conductors." "25. In a branching electric railway, the combination of a track switch, an overhead conductor switch, and a vehicle having a rearwardly extending contact arm, whereby the track switch will operate in advance of the conductor switch. 26. In a branching electric railway, the combination, with a vehicle, of a track switch, an overhead conductor switch, and a contact arm extending upward from the vehicle to the conductor, and so located relatively to the length of the vehicle and the two switches that the lateral movement of the vehicle will give a corresponding movement of the contact device on the conductor switch. 27. In a branching electric railway, the combination, with a vehicle, of a track switch, a contact device consisting of a trailing spring pressed arm having a grooved contact piece embracing the conductor and guided thereby, the said arm being jointed to the car and tending to move laterally therewith, and an overhead conductor switch adapted to engage the contact piece, and whereby the extremity of the arm is flexibly guided from main to branch conductor."

Trade and Industrial Notes.

THE WESTERN ELECTRIC COMPANY, Chicago, has recently mailed to the trade copies of its tool catalogue No. 3. If any of our readers failed to receive a copy one will be sent upon application.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., has placed Mr. W. S. Smith in charge of its Western branch at Chicago. Mr. Smith has been connected with the Bliss Company for a number of years and is a Westerner by birth.

MESSRS. PASS & SEYMOUR, Syracuse, N. Y., have just made a shipment of 16,000 porcelain pieces, aggregating nearly 2 tons, to Mexico. The popularity of the goods of this company is making tremendous strides, not only at home, but in the foreign markets.

A MEETING of the shareholders of the Phœnix Carbon Manufacturing Company will be held at the office of the company, St. Louis, Mo., on August 31, for the purpose of considering and acting upon a proposition to increase the capital stock of the company from $160,000 to $500,000; and also to consider and act upon any other matters which may be brought before the meeting.

EXTENSIVE ADDITIONS.—The Walker Company, on account of rush of work and consequent need of additional space, has found it necessary to add to the large machine shops it already possesses at the Cleveland works. These machine shops alone consist of three bays, each 400 feet long, and the addition will consist of a fourth bay. Work is being rapidly pushed, and the new bay will be shortly completed and ready to receive the large machine tools which are to be placed there.

THOMAS & BETTS.—Robert McKean Thomas, formerly assistant chief inspector in the New York City Electrical Bureau, and Hobart D. Betts, who was connected with the inspection bureau of the Edison Electric Illuminating Company, have formed a partnership, the firm being known as Thomas & Betts. Both are well and favorably known to all interested in electrical work in this city. Their offices are at 141 Broadway, Washington Life Building, where they will engage in electrical engineering. They are agents for Loricated Conduit, manufactured by the Safety Conduit Company, Rankin Station, Pa.; the Helios arc lamp, made by the Helios Electric Company, Philadelphia, Pa., as well as for the refrigerating apparatus of the Hygienic Refrigeration Company, whose factory is at Bridgeport, Conn.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing and erecting for the People's Light & Power Company, Jersey City, N. J., a new boiler house in connection with its electric plant. The building is a modern structure in every respect. It is 60 feet wide and about 90 feet long, contains ample space for large upright boilers, and has an arrangement for the storage of coal in the steel bunker inside the building, so that the fuel can be easily taken direct to the boilers. The tracks are arranged so that railroad cars will run into the building and discharge the coal directly into the bunker. It is of fireproof construction throughout, with steel frame, brick side walls and iron-roof covering, well lighted and ventilated. Sandford & Stillman, of Jersey City, have the contract for the building.

MESSRS. W. C. STERLING & SON, Monroe, Mich., report an excellent business in cedar poles, ties and cross arms this spring and summer. They have prepared for a large demand for their stock, and have their poles piled and sorted at their eleven yards ready for prompt shipment, for which they are noted. This firm has catered to the electrical construction trade almost from the beginning of its business in 1880, and is one of the oldest cedar firms in the pole business in this country. They have handled many hundreds of thousands of poles and ties, establishing so thorough a business that they dispose of their stock to old customers and the regular trade without putting a representative on the road. Their stock can be depended upon as being of the best. They are also heavy stockholders in independent telephone companies.

THE WALKER COMPANY has secured a contract from the Union Carbide Company, of Chicago, for electric machinery of the alternating type for the calcium carbide plant at the falls of Sault St. Marie. The order calls for twenty 500-hp alternating current generators, single-phase, sixty cycles, to deliver a current of 2500 amperes at 200 volts. Besides these there will be five 100-hp direct-current generators, to be used as exciters, and a complete switchboard. The Union Carbide Company has acquired rights of manufacture of calcium carbide for the United States, and will have its main works at Sault

Ste. Marie. The output of the Soo plant will be about 100 tons per day. The works are to be built for the accommodation of forty generators and forty electric furnaces. This contract, which is the initial order for the apparatus for this plant, is said to be the largest ever placed at one time for alternating machinery.

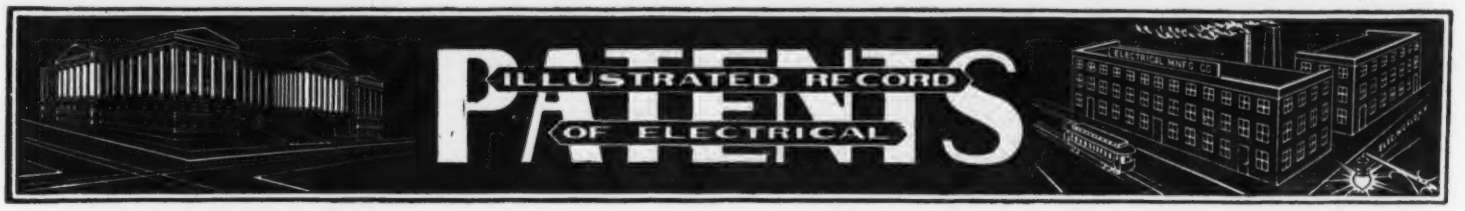
THE BABCOCK & WILCOX COMPANY, of New York, manufacturer of the water-tube boiler of that name, has just gotten out the thirteenth (1898) edition of its magnificent book, "Steam, Its Generation and Use," together with its catalogue. This edition, like all previous editions, is one of the handsomest volumes of its kind ever gotten out, and treats in a most practical and interesting way of the boiler, its uses and misuses, its history, practical conditions and problems which have had to be met with, and showing the gradual and careful steps in the evolution of the Babcock & Wilcox water-tube boiler. The book is beautifully illustrated, not only with cuts of the Babcock & Wilcox boiler, but also with interesting scenes from all over the world, showing the prominent buildings and structures, the operation of which is dependent upon this boiler, which is so widely distributed. It is a book that no central station manager or manager of an isolated plant, architect or engineer should be without. Judging from the enormous editions gotten out from year to year, it is certainly not the fault of the Babcock & Wilcox Company if everyone interested is now provided with a copy. It is a most valuable addition to anyone's library.

THE NON-POLARIZING DRY BATTERY COMPANY, 625 Broadway, New York, is meeting with success with its non-polarizing dry battery. This battery is known as the "O. K." dry battery, and the fields for its use and the demand for it in these fields are rapidly increasing. The fact that the company is supplying the largest independent telephone companies and leading railways for signal work, and also that the battery has been adopted by the United States Government, whose standard everyone knows is of the highest, is certainly proof of the excellent qualities it possesses. The battery is always instantly ready for use, and can be placed anywhere. The company claims that it is not affected by heat or cold. Its use in conection with bell work, telephones, medical batteries, cataphoric boxes, bicycle bells, etc., is increasing every day. The battery has remarkable recuperative power after severe work. The batteries are made in five sizes, and can be furnished either square or cylindrical in shape. It is claimed that it will do the work of an ordinary wet battery of four times its size. The Non-Polarizing Dry Battery Company is publishing some very interesting circulars in regard to the O. K. battery, which will be cheerfully sent on application

THE E. G. BERNARD COMPANY, Troy, N. Y., has completed its contract for finishing the electrical work in the state capitol at Albany, N. Y. The company contracted to do this work in thirty working days, but finished it five days ahead of time. It was thought by the authorities in charge to be a physical impossibility to do the work in less than sixty days, at the least. All the other competitors, it is stated, required eighty-five to ninety days. The company installed about 7000 lights, including switchboards, mains, feeders, branches, etc. This contract is thought to be one of the most difficult of the kind ever undertaken and accomplished in such a short time. There were about sixty granite newel posts, in which a vertical hole 9 to 17 feet long and 2 inches in diameter had to be drilled. These vertical holes had to be met by horizontal holes, running from 4 to 8 feet long. In drilling the horizontal holes, the men were obliged to lie in trenches about 18 x 20 inches. All the wire used was special, and special dies had to be made in order to get the right size of lead covering. The alloy of this wire was also special and different from the standard. All switchboards, cabinet boxes and floor boxes were especially designed. About seventy-five men were employed on the work. The accomplishment of this difficult piece of work is certainly very creditable to the Bernard Company, and shows the ability and facilities of the company for rapidly installing large and special work in its line.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED JULY 5, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,676. STORAGE OR SECONDARY BATTERY; R. Ashley, of Port Republic, N. J. App. filed April 9, 1898. An electrode for a storage or other battery consisting of the horizontal, straight and corrugated metal strips alternating with each other, and the spacing pieces between the ends thereof and soldered thereto.

606,646. RHEOSTAT; H. B. Cutter, of Philadelphia, Pa. App. filed June 22, 1897. The combination of a rheostat, an automatic magnet circuit breaker, adjustable with respect to the normal flow of current necessary for its actuation and means for preventing the closing of the circuit breaker when the rheostat arm is in certain positions.

606,658. MACHINE FOR PUNCHING TELEGRAPHIC PAPER; G. M. Gibson, of Chulmleigh, England. App. filed July 26, 1897. The combination of three rows of punches, cross bars fixed to the punches of the middle row, collars on the other punches bearing on the cross bars, and means for operating the punches of the two outer rows.

606,663. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed March 28, 1898. An electric controller, comprising an insulating cylinder, a series of contacts mounted thereon, a plurality of annular magnets surrounding and mounted on said cylinder, and having extensions projecting into proximity with such contacts.

606,664. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed April 7, 1898. The combination with two electric motors having their field magnets connected in circuit by connections independent of their armatures, of controlling devices for changing the said field magnets from series to parallel relation.

606,693. AUTOLUMINOUS COMPOSITION; A. Syssoyeff and L. Braly, of Lyons, France. App. filed Dec. 14, 1897. An autoluminous composition formed of a mixture, in suitable proportions, of the soluble sals of rhodium and ruthenium freed from elements foreign to their group or family, and the soluble salts of cerium and vanadium, in suitable proportions.

606,711. TROLLEY HEAD; C. Grover, of Kansas City, Mo. App. filed Nov. 13, 1897. In a trolley head, the combination with a fork of a tubular spindle mounted therein, a trolley wheel mounted to rotate upon said spindle, said spindle provided with an opening through the wall thereof, and a contact plug arranged with said tubular spindle and projecting through said opening and into contact with said wheel.

606,726. INCANDESCENT LIGHTING SUBSTANCE; William Mahler, of New York, N. Y. App. filed July 31, 1897. A mantle or hood for incandescent lighting, composed of a large percentage of thorium oxid, a small percentage of cerium oxid considerably smaller than the percentage of cerium oxid.

606,746. ELECTRIC-LIGHT SWITCH; F. L. Temple, of St. John, Canada. App. filed Oct. 7, 1897. In an electric-light switch, the shears-like levers or members, having their upper portions or jaws adapted to readily receive between them the inner end of the door key, and the spring metal electric conductors, with their lower ends adapted to be connected to electric wires, and having upper end engaging contact points, said levers or members also having insulated projections or studs adapted to engage said spring conductors and hold said contact points in engagement with the aid of the door key.

606,761. METHOD OF AND APPARATUS FOR GENERATING ALTERNATING CURRENTS; M. Hutin and M. Leblanc, of Paris, France. App. filed March 13, 1894. The method of generating alternating electric currents by causing electrical alternations of the desired frequency and reinforcing the same to the desired volume.

606,762. ALTERNATING CURRENT DYNAMO; M. Hutin and M. Leblanc, of Paris, France. App. filed April 19, 1895. The method of generating alternating electric currents, by rotating an armature circuit or circuits closed upon themselves, within inductive proximity to a resonant circuit traversing an alternating magnetic field or fields, with a speed exceeding the frequency of electrical oscillations in the resonant circuit, divided by half the number of poles of the field.

606,764. TELEPHONE EXCHANGE; F. A. Lundquist, of Chicago, Ill. App. filed May 19, 1897. In a circuit closing device, a crank, a pitman connected thereto, a mercury receptacle into which said pitman is thrust by said crank, means for causing said crank to stop at a fixed position, and connections for permitting said crank to be rotated by the hand.

606,769. ELECTRIC HEATER OR RHEOSTAT; D. Van Rensselaer Sill, of New York. App. filed May 29, 1897. An electric heater or rheostat, consisting of an outer shell and a resistance filling therein in the form of a spiral layer or comminuted material with the convolutions in contact.

606,771. FUSE BOX; J. B. Smith, of Manchester, New Hampshire. App. filed Feb. 23, 1897. In a fusible cut-out, the combination, with a box provided with partitions, the upper edge of each of which is provided with a notch, and the inner edges of the walls of the box is recessed or provided with a shoulder even with the top of the partitions, the notches being out of alignment with each other and the central partition being provided with a shouldered opening extending from the bottom of the box to the top of the partition, and each end wall of the box being provided with an opening, a cover for the box provided a series of openings, the central one of which registers with the openings in the middle partition, and each of the other openings registers with the compartment between two partitions, a bolt through the box and the cover, the head of which fits within the larger portion of the opening in the partition and the point projects above the cover, a spring between head of the bolt and the shoulder of the opening, a nut upon the bolt above the cover, a binder in each end compartment, and a fusible connector secured at its ends to the binders and having its intermediate portion passed through the notches in the partitions.

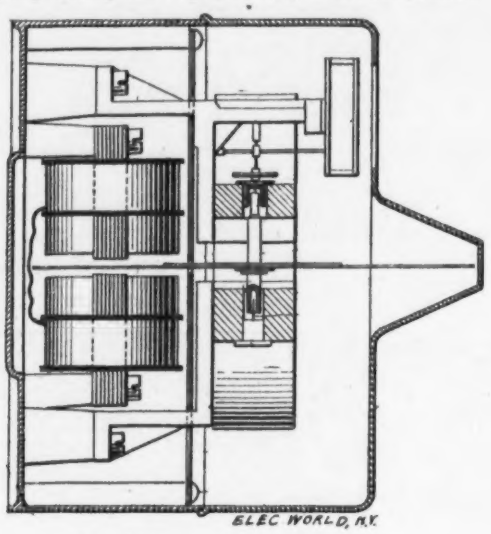
606,792. ELECTRIC RADIATOR; F. W. Quidas, of Mount Washington, Md. App. filed July 22, 1897. The combination in an electric heater, of a resistance, a casing surrounding the same, a block of poor heat conducting material inclosing the back of the casing and in contact with it and having a portion of said material extending along the edges of the front to hold said casing in the block.

606,795. ELECTRIC METER; W. Stanley, of Pittsfield, and F. Darlington, of Great Barrington, Mass. App. filed Jan. 13, 1898. In an electric meter, a magnetic brake consisting of a rotating disc mounted upon the shaft to be

retarded, and a permanent magnetic system having a permanent magnet provided with a soft-iron pole piece and adjustable projections engaging with said soft-iron pole piece.

606,803. TELEPHONE SYSTEM; B. R. Dodge, of Post Mill Village, Vt. App. filed June 17, 1897. A party-line telephone system, having two main metallic leads and a plurality of stations, each station comprising a talking circuit, a signaling circuit and a telephone switch, alternately closing the circuits, the signaling circuit having a ground tap and the signaling circuit also having a signaling bell, a generator and a resistance, the resistance being in parallel with the generator and in series with the bell, and the talking circuit also having a switch for normally holding the resistance in the closed circuit and capable of throwing the bell into such circuit to the exclusion of the resistance.

606,819. CONTACT DEVICE FOR ELECTRICALLY PROPELLED VEHICLES; H. P. Davis, of Pittsburg, Pa. App. filed April 6, 1896. A locking head comprising two plates separated by an intervening space, a pair of dogs pivoted in said space and projecting inwardly toward each other, and a spring holding said dogs yieldingly in normal position.



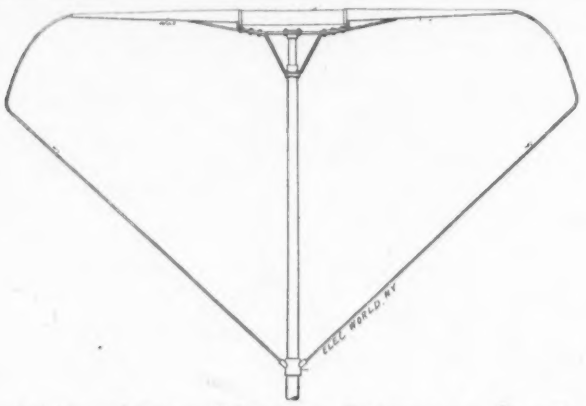
No. 606,795.—Electric Meter.

606,825. CONTACT DEVICE FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed March 2, 1896. In a contact device for electric railways, a cylindrical roller, bearings therefor, a shaft carrying the roller, a fork receiving the respective ends of the shaft, slots formed in the arms of the fork through which said shaft is inserted and wearing pieces covering said slots.

606,826. CURRENT COLLECTING APPARATUS FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed April 6, 1896. In a current collector for railway vehicles mounted to turn upon a vertical axis, a locking device normally acting to prevent such turning movement and means actuated by the downward movement of the collector to release the same from the locking device.

606,827. OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed June 10, 1896. An overhead supply conductor for electric railways having an insulated section bridged by an auxiliary section, a second supply conductor extending at an angle to said first-named conductor, and a casting having arms extending in the direction of the crossing conductors and fastened thereto, one of said arms having a narrow groove at each side of the other arm to receive the flanges of a trolley wheel.

606,828. TRAVELING CONTACT DEVICE FOR ELECTRIC RAILWAYS; George Westinghouse, of Pittsburg, Pa. App. filed April 6, 1896. The combination with a contact device and its supporting arm, of a tubular reversing boom, a coiled spring seated therein, and means extending through said boom and connecting said spring with a projection from said supporting arm, whereby the arm is normally yieldingly supported in an elevated position.



No. 606,819.—Contact Device for Electrically Propelled Vehicles.

606,830. INSULATOR; B. Willard, of Schenectady, N. Y. App. filed April 18, 1898. In an insulator for an electric conductor, the combination of a metal cap having a receptacle which is other than round, with a body of insulating material arranged to fit into the cap and be free to move in and out, but prevented from turning therein, and means for securing the insulator to a support.

606,852. TELEPHONIC TRANSMITTER; T. F. Ahern, of Detroit, Mich. App. filed June 19, 1897. An electric telephone transmitter or analogous device to be operated by varying electric currents, consisting of two substantially triangular carbon electrodes placed in frictional contact, the area of which is varied by the sound vibrations of the diaphragm carrying one of the electrodes.

606,863. ALTERNATING CURRENT DYNAMO; L. Guttman, of Peoria, Ill. App. filed Dec. 4, 1897. In an iron-clad inductor alternator, the combination with one or more stationary annular armature cores and windings for the same, of a stationary field winding, a field core for said winding, in three solid and separate structures, and a removable shaft for said field magnet core.

606,865. POLICE PATROL SYSTEM; O. W. Hart, of Fall River, Mass. App. filed Aug. 3, 1897. A telephone transmitter, consisting of a case, a mouthpiece on the front of the case, a diaphragm at the rear of the case, a plurality of electrodes extending from the diaphragm toward the mouthpiece and provided thereat with a rigid support and with means of adjustment.

606,884. ELECTRIC SNAP SWITCH; A. F. Wood, of Philadelphia, Pa. App. filed Oct. 8, 1897. An electric snap switch, consisting of a suitable casing, a disc journaled therein, a lever pivoted concentric with the disc, a spring connected between said disc and said lever, two dogs pivoted to the lever, a locking plate with which the noses of the dogs are adapted to engage, a spring drawing said dogs together and means for oscillating said disc.

606,887. ELECTRIC EXTRACTION OF POISONS; J. B. Campbell, of Cincinnati, Ohio. App. filed Oct. 5, 1896. The herein described method of extracting poisons from the human body, consisting in providing the negative electrode of an electric battery with interchangeable receivers of animal, vegetable or mineral substance, to extract a poison from the body of a nature or kind corresponding with or to the negative electrode employed.

606,912. MEANS FOR PREVENTING DISTURBANCES IN TELEPHONIC CIRCUITS; A. T. Blathy and K. De Kando, of Buda-Pesth, Austria-Hungary. App. filed April 27, 1897. Monophase or polyphase alternating current plants which have one of the conductors grounded, with alternating currents of a frequency less than twenty complete periods per second, in combination with monophase or polyphase alternating current motors with slantwise slots, for preventing disturbing influence on telephone apparatus.

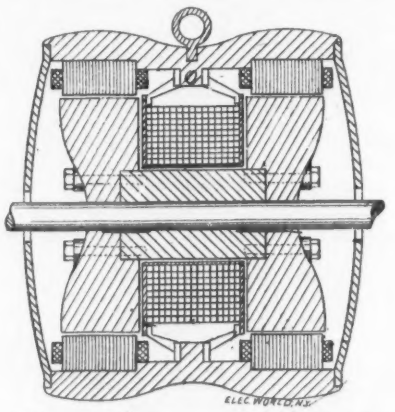
606,917. ELECTRIC BRAKE; H. P. Davis, of Pittsburg, Pa. App. filed Oct. 22, 1897. In an electric braking apparatus, a plurality of electric motors arranged in parallel in a local circuit to be driven by generators, in combination with a plurality of brake magnets, one in each branch of such circuit.

606,921. COMPOSITION OF MATTER FOR ELECTRIC HEATERS; G. B. Fraley, of Philadelphia, Pa. App. filed Aug. 12, 1897. A composition of matter consisting of talc, silicate of soda, carbonate of soda and water.

606,939. SWITCH FOR ARC LAMPS; C. A. Pfluger, of Chicago, Ill. App. filed Dec. 21, 1896. A switch for electric circuits, comprising four terminals divided into pairs, an arm associated with each pair of terminals and adapted to connect the terminals of the respective pairs together, a conducting controlling arm located between the pairs of terminals and adapted to become part of the circuit at predetermined times, said controlling arm adapted to operatively engage said arms when in a predetermined position, and move them both into and out of contact with their opposed terminals.

606,954. LIGHTNING ARRESTER; W. E. Athearn, of Brooklyn, N. Y. App. filed Aug. 9, 1897. A lightning arrester, comprising a porcelain block, having a spiral moulded on its middle portion to receive a coil of wire, one end of the block provided with a connector to receive one end of the coil and one end of the line, the other end of the block having two connectors, one for the coil terminal and one for the other end of the line, the two connectors being connected together by a fusible wire, the whole mounted on a base with a ground plate contiguous to the coil.

606,990. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed April 18, 1898. The method of changing the armatures of a two-motor car equipment from series to parallel connection, which consists in closing a shunt around one of the armatures of such resistance as to substantially divert the line current from the armature without the production of a short circuiting current through the armature.



No. 606,863.—Alternating Current Dynamo.

606,991. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed April 25, 1898. The combination with two electric motors having their field magnets and armatures in separate circuits and a controller for regulating the field magnets and armatures thereof, of a supplemental switch arranged to independently vary the resistance of said field magnet circuit.